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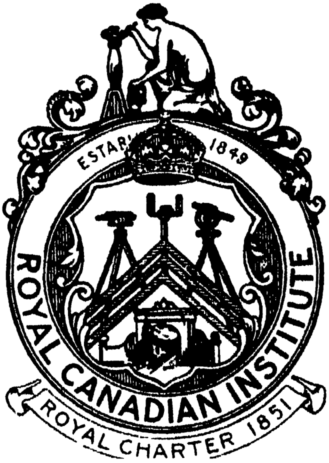

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A DISEASE OF THE SCOTS PINE (*PINUS SYLVESTRIS* L.) CAUSED BY THE FUNGUS *DIPLODIA PINEA* KICKX ASSOCIATED WITH THE PINE SPITTLE-BUG (*APHROPHORA PARALLELA* SAY.).*

I. SYMPTOMS AND ETIOLOGY

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1. INTRODUCTION

During the last twenty-five years Scots pine has been extensively planted in southern Ontario for reforestation and other purposes. Today the aggregate area occupied by it in forest plantations, shelterbelts, etc., is very large and is ever expanding. In spite of a growing use of native pines, the popularity of Scots pine persists, as evidenced by increased distribution of it from government nurseries. In some districts, notably Norfolk county, it has led in public favour for many years, regularly outdistancing there its nearest competitor, the red pine.

Scots pine possesses qualities for which it is valued both in the nursery and for planting out. It is comparatively easily and cheaply brought to shipping size. Probably none of our conifers is less exacting with respect to site requirements. It grows well on sand and on loam, even when there is a high content of clay. It thrives under the extremes of dry hill top and moist creek flat. It recommends itself particularly for windbreak and shelterbelt. For timber production, while certain forms of the species are definitely undesirable in southern Ontario, the best are very promising with respect to rate of growth and quality of timber. Much remains to be learned about the maintenance of stands throughout rotations suitable for quality growth; but already the good reproductive capacity of the species has been demonstrated here.

Young plantations are almost invariably successful, even on the poorest sites commonly available; but it is a common observation that many begin to deteriorate in their second decade or later, and sometimes suffer severe mortality from causes which often remain obscure. In the last few years several instances of destructive epidemic disease have been investigated, and a common cause was discovered in the association on the host of the fungus *Diplodia pinea* Kickx and the pine spittle-bug *Aphrophora*

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parallela Say. This association and its harmful results have not been reported heretofore, although each agent has been investigated individually, and has been credited with more or less noxious potentialities. The following comprises a record and discussion of original observations and experiments relating to the disease and a review of the literature pertinent thereto.

2. HISTORY AND IMPORTANT LITERATURE

It is commonly believed that the pine spittle-bug is harmful to its hosts. Knull (17) thought it was able to kill trees outright and ascribed an immense amount of injury to Scots pine plantations throughout Pennsylvania to its attacks. According to Nace (23) injuries caused by spittle-bugs often resulted in the death of twigs and branches and occasionally whole trees. He described one case in which a mortality of from fifty to seventy per cent was suffered in an eighteen-year-old plantation, but said that such instances were rare. McIntyre (22) referred to the spittle-bug epidemic of 1935-38 in the Hudson valley and said that, in some localities there, practically all the Scots pines over twenty years old were killed. MacAndrews (21) said that Scots pine plantations in various parts of New York State had been killed off. He thought that in some cases the mortality was to be attributed in part to two or more kinds of mites which he found in abundance on the trees, but ascribed the damage in the main to spittle-bugs. Brown (3) reported that *Aphrophora parallela* was especially abundant over a wide area in northern Ontario and Quebec in 1939, and suggested that it was associated in some obscure way with a blight of white pine foliage.

With respect to the fungus *Diplodia pinea* only slight notice has been given to it in America by plant pathologists. Its close relative, *Diplodia natalensis* (=*Physalospora rhodina* (Berk. and Curt.) Cooke, according to Stevens (29)), commonly found on citrus hosts, has received a good deal more attention. *Diplodia pinea* has been reported not infrequently as a saprophyte and occasionally as a parasite in association with twig blights of conifers. Crandall (5) recently attributed a root and collar disease of red pine seedlings in Maryland and Wisconsin nurseries to *Diplodia pinea*, under the name *Sphaeropsis Ellisii*. From Long Island, Waterman and Miller (31) reported a die-back of *Pseudotsuga taxifolia*, also noted on *Pinus nigra*, *Pinus Strobus* and *Picea pungens*, with which a fungus identified as a species of *Sphaeropsis* was associated. Subsequently Waterman (30) diagnosed the fungus as *Sphaeropsis Ellisii* (=*Diplodia pinea*), and extended the host list to include *Pinus sylvestris*, *P. resinosa*, *P. montana*, *P. ponderosa*, and *P. virginiana*. She said that the disease was widely distributed in the eastern and mid-western United

States. In his recently published book Pirone (27) has given a summary account of this malady under the name "*Sphaeropsis* tip blight of conifers".

In Europe, as in America, the fungus has been connected with a twig blight. A short note published anonymously (1) stated that a pine shoot blight, specimens of which were commonly received at Kew for diagnosis, was due to *Diplodia pinea*. Inoculation experiments were described in which infections were induced in *Pinus Strobus* and *P. sylvestris*, and it was suggested that insect wounds were infection courts in nature. In 1913, Petri (26) reported and described a twig and branch blight of Douglas fir planted in Italy, which he said was caused by *Sphaeropsis Ellisii*. Goidànich (13) recently found what he called *S. Ellisii* var. *chromogena* on lumber of *Pinus pinea*, and also in the roots of living trees. The fungus was said to have entered the host through wounds caused by pruning and beetles. Prodan (28) gave a short account of *Diplodia pinea* as a parasite on twigs and foliage of Scots and Austrian pines in Roumania.

While in North America and Europe *Diplodia pinea* is known as the cause of a twig blight of relatively minor importance, in the antipodes it has been recognized as a destructive forest parasite. Important studies of its work have been made in South Africa, Australia and New Zealand. It has caused great damage in plantations of conifers introduced on a large scale for purposes of afforestation. In a paper on the fungal diseases of timber trees in South Africa, Elaine M. Laughton (18) said that of the pines, *Pinus radiata* was most susceptible, and that its worst enemy was *Diplodia pinea* (which she called *Sphaeropsis pinicola*). In some districts whole plantations were said to have been quickly destroyed by it. F. S. Laughton (19) also recognized *Diplodia pinea* (under the name *Sphaeropsis pinicola*) as the immediate cause of widespread destruction in plantations in the Transvaal, Natal, the Eastern Cape Province, and in parts of the Midlands, but argued that the trouble was essentially related to climate, in that deleterious soil conditions, particularly fluctuations between drought and water-logging, predisposed the trees to disease. According to Young (32) *Diplodia pinea* and *Diplodia natalensis* are the most important parasites of exotic pines in Queensland. The former has demonstrated there a dangerous pathogenic potentiality and, in the interests of forest protection, the planting of species most susceptible to its attack was abandoned.

In New Zealand Miss K. M. Curtis (6) described a die-back of *Pinus radiata* and *P. muricata*, which she attributed to *Botryodiplodia pinea* (=*Diplodia pinea*). In a recent publication Birch (2) said the fungus was common throughout New Zealand as a saprophyte or weak parasite in pine plantations. He estimated its significance as a forest parasite as not very great, but said it was of considerable economic importance as a cause of sap stain in lumber and other wood products.

It is noteworthy that *Diplodia pinea* disease of *Pinus radiata* in South Africa follows initial injury to the very tender bark of that species by hailstones, and that the development of epidemic conditions there is held to be dependent very largely on the occurrence of hail storms (18). The same holds true in Queensland, but it is of interest to note that Young observed the association of *Diplodia pinea* with a scale-like insect, and suspected that it had a pathological significance.

3. DIPLODIA PINEA DISEASE IN ONTARIO

In southern Ontario *Diplodia pinea* disease has occurred in three ways, as follows: (1) A tip and twig blight of various conifers, in plantations and in the natural forest. This is the "*Sphaeropsis* tip blight" already described in the literature. It is endemic and ordinarily rare enough to be of little significance in the forest, other than in its relationship to type (3) to be described. (2) An epidemic tip blight of young Scots pine planting stock in transplant lines. This trouble occurred as an adjunct to type (3), when *Diplodia pinea* had become exceedingly abundant in nearby plantations or shelterbelts. It has never assumed a very serious character, though under conditions most favourable for its development it has damaged about five per cent of the stock exposed. It results from infection at or near the terminal bud cluster, the court or courts being unknown. (3) A lethal, epidemic bark disease of twigs, branches and stems of Scots pines, particularly those over fifteen years old, characterized by massive crown infection and close spread, which often causes the death of whole trees. This is the disease with which we are chiefly concerned here. Its development in Ontario has been dependent on an association with the pine spittle-bug. When the latter becomes epidemic the trees are conditioned for mass infection, which in turn leads to a rapid multiplication of the amount of inoculum available. Type (1) has a significance here, in that it maintains initiating infection foci. In some respects this malady resembles the beech bark disease studied by Ehrlich (9).

Diplodia pinea blight has been very destructive locally. One twenty-five-year-old plantation was so badly damaged that the whole stand was felled. In another instance approximately 5,000 dead or dying trees were removed in salvage and sanitation cuttings from plantations of that age comprising thirty acres.

4. THE PINE SPITTLE-BUG (*Aphrophora parallela* SAY.)

The pine spittle-bug was studied in some detail by Osborn (24) who, in his monograph on the froghoppers of Maine, quoted Fitch's original description of it and gave several figures of his own. According to our observations the life-history and habits of the insect may be briefly described as follows: The nymphs, enveloped in spittle, appear just below the expanding buds about the middle of May. At first each small spittle mass contains a single nymph, or rarely two or three (Table No. 1). As the masses enlarge and coalesce, the nymphs become aggregated. The spittle begins to drip downwards, wetting twigs, branches and trunk, and even the ground beneath the trees, when the latter are heavily infested. The nymphs work slowly inwards, neglecting the current season's shoots, but remaining on young internodes. Shed skins (and often large quantities of pollen) can be found in the spittle. According to Osborn, there are five instars. The last moult is from the tips of the needles, where the skin remains attached.

TABLE No. 1

FREQUENCY TABLE—NO. OF NYMPHS PER SPITTLE MASS†

No. of Nymphs	Frequency
1	24
2	8
3	1
5	1
7	1

†Examined, May 13th.

The adult is a dusky flattish bug about 1/3" long, the female bearing a conspicuous clavate ovipositor. Adults were observed emerging early in July. After a period of hardening and colour change (they are light at first), they became active. On warm sunny days they were seen running over the branches. They are strong jumpers, and the impact of their falling bodies on the dry leaves on the ground is distinctly audible, and is a characteristic sound in heavily infested plantations in midsummer. (Earlier in the season the dropping of spittle is often heard). The insect springs forward with a spasmodic action of the legs. In the air the wings may be vibrated, but flight is rarely prolonged, the distance travelled depending usually on the initial impulse. The legs attempt to clasp any object met with in flight. In mid-summer a fine spray can often be seen falling from the trees. It results from the activity of innumerable adult spittle-bugs, each of which ejects periodically from its anus a short series of tiny droplets.

Both nymphs and adults feed on the host. The mouth-parts are modified into a suctorial apparatus, which encloses the stylets. In young nymphs this organ is about 1 mm. and in adults up to 3 mm. long. The stylets are inserted through the periderm into living cells, from which nutriment is withdrawn. The nymphs feed mostly on the shoots on which they were born. Adults range widely, feeding on the younger internodes, including those of the current year, which, however, seem to be less favoured than older growth.

An estimate was made of the number of spittle-bugs present under conditions of heavy infestation. A tree 6″ d.b.h. and 24′ tall was selected. In early June, when still quite small, the spittle masses and nymphs were counted on a branch system which comprised about one-tenth of the total foliage. It was estimated that the tree supported 1,500 spittle masses and 2,000 nymphs. On July 6th, when the spittle had disappeared, adults were counted on a ten-foot tree. Forty-one were found, of which twenty-nine were on internodes of the last four years when observed. There were besides fifteen dead attached to the bark by their stylets. (Table No. 2.)

TABLE No. 2

EXAMINATION OF 10 FT. TREE FOR ADULT SPITTLE-BUGS—JULY 6TH, 1939

Year of shoot formation.	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924	1923	1922	
No. of living adult spittle-bugs............	7	10	6	6	3	2	2	0	0	0	2	0	0	1	1	0	0	1	Total—41

The number of feeding (stylet) holes is sometimes very great. On certain trees they could be seen under low magnification for four years back. Internodes which had been exposed to three years' feeding, bore almost twenty holes per centimeter of length examined. (Table No. 3)

TABLE No. 3

NO. OF SPITTLE-BUG STYLET WOUNDS—JULY 6TH, 1939

Year of shoot formation..................	1939	1938	1937	1936
Length of shoot examined (cm.)...........	43	30	48	18
No. of stylet wounds.....................	7	12	505	352
No. of stylet wounds per cm..............	0.2	0.4	10.5	19.5

An old stylet hole appears superficially as a minute puncture at the apex of a slight hemispherical swelling which erupts the overlying phellem. (Fig. 10.) In a transverse section of the shoot the stylet "track" was seen as a sheath of hard material which surrounded the piercing organ. Peripherally to this was a zone of dead cortex and phloem, sharply delimited from the living tissues by a narrow boundary of phellem. (Fig. 13.) When uninfected, these little cores of dead tissue could be easily lifted out intact on the point of a needle. They are successfully "corked out", and lead only to a superficial roughness of the bark, to be sloughed off completely at length. There is no important disturbance of the normal contour of the branch surface.

The penetration of the stylets is often deep. In the case of adults feeding on young internodes, the cambium may be reached. Traumatic false rings are induced, which are not unlike small frost rings, but occur in the late wood. (Fig. 13.)

Spittle-bugs thrive on vigorous, healthy trees. It has been observed repeatedly that suppressed, slow-growing trees, if infested at all, are unable to maintain the parasite. The nymphs fail to grow well, and often die, the spittle masses drying up early in the season.

The death of Scots pine has often been attributed to spittle-bug infestation. Nevertheless, isolated trees and whole plantations have been observed to suffer heavy infestation repeatedly without apparent gross injury. An unexplained withering of foliage and twigs, characterized by pale colour, has been noted not uncommonly in infested trees. The sequent killing of shoots by a *Pityophthorus* beetle is a common phenomenon, which has already been noted by Knull (17). By far the worst effects observed have followed the invasion by *Diplodis pinea* of spittle-bug infested trees. That is the cause of the blight disease to be described.

5. THE FUNGUS *Diplodia pinea* KICKX

A. DIAGNOSIS AND NAMES

From the examination of abundant material collected at several localities in Ontario, it was apparent that a single fungus species was associated with Scots pine blight. This fungus agreed with descriptions of *Diplodia pinea* Kickx and with specimens in exsiccati under that name, or referable there, with which it was compared. An examination of spec. No. 274, Fungi exotici exsiccati of Sydow, under the name *Sphaeropsis pinastri* Speg., from *Pinus halepensis* in South Africa, tends to confirm the view held by E. M. Laughton (18) and F. S. Laughton (19) that that species, named from a collection on *Pinus radiata* in Argentina, is the same as *Diplodia pinea* Kickx. From our own studies we have concluded that *Phoma Pinastri* Lév., *Diplodia conigena* Desm., and *Sphaeropsis Ellisii* Sacc., are synonymous with the above. This is in close agreement with Grove (14) who, however, retained *Phoma Pinastri* Lév. under the combination *Diplodia Pinastri* Grove, and said that there was little reason for considering *Diplodia pinea* Kickx other than a form of it. For reasons of priority, the latter name should be retained.

Table No. 4A is adapted for comparative purposes from the original descriptions. *Diplodia conigena* was said by its author to differ from *Sphaeria pinea* in the colour of the interior of the pycnidium. Since the colour changes from white to black with age, that feature is of little diagnostic value. The septation of spores is not a reliable character. The description of the ostiole of *Sphaeria pinea* as "conical" is drawn from a misinterpretation of the extruded spore mass, which often dries as a cone at the mouth of the ostiole, and can be washed or broken off.

A number of varieties have been named under *Sphaeropsis Ellisii* Sacc. Peck (25) described var. *Laricis* from *Larix americana* and said that its perithecia were larger than in the typical form, with spores 15-20×30-45 microns. Fautrey (10) described a variety *Abietis* from cones of *Abies pectinata*, with spores 12-14×36-40 microns. Goidànich (13) recently described var. *chromogena*, which he found on *Pinus pinea*.

TABLE No. 4A

TRANSCRIPTION OF ORIGINAL DESCRIPTIONS

Name	Date	Spores	Fructification, host and substratum
Sphaeria pinea Desm.......	1842	Large, about 30 microns; some uniseptate.	Dark, erumpent in sinuous rows rarely gregarious; white within, becoming grey; ostiole conical, finally deciduous. On bark and foliage of *Pinus sylvestris*.
Diplodia conigena Desm.....	1846	16×30-35 microns; rarely septate.	Dark, innate then erumpent, gregarious; black within; ostiole lacking. On cone scales of *Pinus sylvestris* and *Pinus abies*.
Phoma Pinastri Lév........	1846	Large, non-septate.	Innate, gregarious, black within and without; ostiole protruding. On cones and foliage of *Pinus sylvestris*.
Diplodia pinea Kickx......	1867	Large, at first non-septate, then septate; dark when ripe.	Dark, erumpent, more or less aggregated, or often arranged in flexuous rows on the bark; solitary on the foliage; opening by a pore. On bark and dry needles of *Pinus sylvestris*.
Sphaeropsis Ellisii Sacc.....	1884	12×30 or 35-40 microns.	Sub-gregarious; papillulate. On bark of *Pinus sylvestris*. New Jersey.

It may be questioned, perhaps, whether *Diplodia pinea* Kickx differs from *Sphaeria sapinea* Fr. (=*Diplodia sapinea* Fckl.). Grove said the latter was probably merely a "form". Only through comparative study of authentic material could the point be settled. Transcriptions of Fries' and Fuckel's descriptions are given in Table 4b.

TABLE No. 4B

TRANSCRIPTIONS OF ORIGINAL DESCRIPTIONS

Name	Date	Spores	Fructification, Host and Substratum
Sphaeria sapinea Fr.	1823	. . . . . .	Dark, erumpent, gregarious; globular; ostiole papillulate, deciduous; at first white-stuffed, then empty. On bark and branches of fir and pine.
Diplodia sapinea Fckl.	1869	Large, with or without septum.	On bark and branches of *Pinus sylvestris.*

There is, however, a small-spored *Diplodia* on conifers, which agrees with *Diplodia pinea* except in spore size. It is exemplified by spec. No. 4778 *Sphaeropsis Pinastri* ((Lév.) Sacc. forma *Abietis* D. and B., in the Fungi Columbiani. It was collected by Dearness in Ontario on the cone scales of *Abies excelsa* Poir. The spores measured by us were 23-27×8.5-11 microns. This fungus has not been found associated with Scots pine blight; its pathogenic potentialities are unknown.

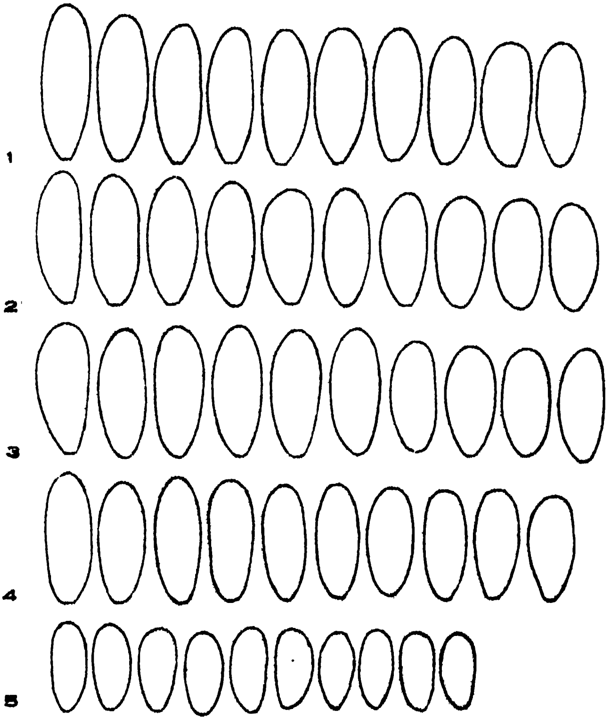
It is of interest to note here that Cooke (4) recorded a collection under the name *Phoma Pinastri,* with spores 10×6-7 microns from "fir" (Scots pine?) in England. *Phoma Pinastri* was described by Léveillé as with large spores, and it seems probable that Cooke misdetermined his specimen. But, as pointed out by Grove, Saccardo copied the spore size given by Cooke into his description of *Sphaeropsis Pinastri,* and was thus led to institute *Sphaeropsis Ellisii* based on large-spored specimens collected on *Pinus sylvestris* in New Jersey.

Outlines of the spores from well-known exsiccati and other specimens are illustrated in Text Fig. No. 1. Those shown 1-4 are referred by us to *Diplodia pinea* Kickx.

DESCRIPTION AND OCCURRENCE

The fructifications of *Diplodia pinea* are dark ostiolate pycnidia, usually globular, but variable according to the character of the substratum; glabrous, slightly papillulate or smooth, though often appearing rostrate on account of a conical accumulation of spores around the ostiole. They are either separate or gregarious, in linear or botryose arrangement.

Typically erumpent, they occur superficially on some substrata. They are black externally, and white inside at first, becoming black centrally on ripening, and ultimately throughout. The ovoid spores, continuous and hyaline until fully mature, at length become dark, and some two-celled. The spores measured by us ranged in size from 12×33 to 16×46 microns. No perfect fructifications were found in nature or in artificial cultures.



Spores from exsiccati (x450):
1. No. 279, *Sphaeropsis pinicola* Speg., Fungi exotici exsiccati, Sydow; No. 2. No. 955, *Diplodia pinea* (Desm.) Kickx, *Mycotheca italica* Saccardo; 3. No. 9210 *Sphaeropsis Ellisii* Sacc., var. *Laricis* Peck, cryptogamic herbarium, University of Toronto; 4. No. 1001 *Diplodia pinea* Kickx, Forest pathological collections, Dept. Lands and Forests, Ontario; 5. No. 4778, *Sphaeropsis pinastri* (Lév.) Sacc. forma *Abietis* D. & B. Fungi Columbiani.

The pycnidia occur on the stem and foliar parts, arising most abundantly on tissue recently killed. They are not conspicuous, but where blight has been prevalent they can be found in surprising abundance by careful search. In dying bark on the trunk and branches they occur beneath the scales, and cannot be seen until these are removed. On younger branches they can be found in fissures between the scales; and on killed new shoots, needles, and cones, they erupt through the epidermis or phellem, making linear or stellate apertures. The most prolific fruiting seen was on a mummified cone, in the apophysis of almost every scale of which there were numerous pycnidia. Fructifications found in winter and early spring were invariably empty, except for occasional spores accidentally retained. Newly matured pycnidia were found in early June, and throughout the summer as conditions became favourable. They commenced to sporulate when wetted. This activity occurs in nature in rainy weather and when the bark is wet from dripping spittle. It was observed in the field and in the laboratory, and was easily stimulated artificially. Spores were expelled from the fructifications in soft masses, which accumulated around the ostiole, or were washed away in long streaks. Whether any were liberated freely into the air is not known with certainty; but none were caught on slides placed just above pycnidia, or in traps exposed in diseased plantations.

Spores are transported from the fructification by rain and by dripping spittle, and doubtless by insects, birds, and other animals. They germinate quickly in water and some were viable eight months after a culture on which they were produced, had been started.

6. THE SYMPTOMS OF *Diplodia pinea* BLIGHT

Incipient blight exists in the "*Sphaeropsis* tip blight" already described in the literature (27). The development of massive infection begins rather deeper in the crown, though still in the peripheral part. The disease becomes a close-spreading crown blight, involving large masses of foliage, through infections on the larger branches and trunk. Ultimately the whole tree may be killed. Much foliage dies uninfected, as a result of the killing of the branches bearing it. The needles turn a rusty brown, and are retained till winter, or later.

In the crowns of blighted trees are to be seen what were called "curled tips". When shoots of the current season are infected early, while still perulate, by spread of the fungus from below, they often become characteristically bent or curled. This is the result of interference with the normal symmetry of growth through the killing of meristematic cells on one side of the shoot. In Scots pine such shoots usually die throughout before maturing, but in red and Austrian pines, which are occasionally infected in this way, they often survive, though permanently deformed by a sharp kink at the point of infection. "Curled tips" become exceedingly brittle through resin infiltration, and appear vitreous in fracture. Fructifications of *Diplodia pinea* have been found on their distal needles while still ensheathed (Fig. 8), on the larger proximal needles already free, on the bracts supporting short shoots, and on the stem.

When shoots of the current year are infected near their distal ends, late in the season, there is a marked stimulation of budding just below the lesion. This was particularly noticeable in the tip blight of 2-2 planting stock, where the effect extended downwards an inch or two in rapidly decreasing intensity, as indicated by decreasing bud size. Most of the buds were axile, proliferated from the growing point between the needles of a short shoot. In a few cases, short shoots near the bases of these young plants were stimulated to fall growth, and produced needles late in the season only slightly shorter than normal, in clusters of twos or threes.

The disease is essentially one of the bark of the younger internodes of branches and trunk. Small local infections which originate in stylet wounds, coalesce and become large lesions. When on internodes making rapid diameter growth, the lesions assume a canker form, through local killing of the cambium. Thus slight ridges, flutings, and other irregularities of the surface arise. (Fig. 12.) From these lesions there is a copious flow of resin, particularly in the early summer, which exudes from fissures in the bark, and from the base of short shoots. It causes conspicuous bluish-white streaks on the bark, and sometimes collects in soft masses in the foliage. Short shoots on infected branches are invaded, and the foliage killed.

On young internodes *Diplodia pinea* infects not only the cortex and phloem, but also the wood, particularly the rays. Hyphae penetrate the pith, where they advance rapidly, causing discoloration and resinosis.

The fungus was regularly isolated from lesions on blighted trees. In Table No. 5 are given the results of culture work in which tissue removed aseptically from the margins of lesions in branches, twigs, and foliage was planted on malt agar.

TABLE No. 5

ISOLATIONS FROM BLIGHTED SCOTS PINE

Date	Tissue removed†	No. of plantings	*Diplodia pinea*	Other fungi	Sterile
Oct. 7	A	8	5	0	3
June 23	A	9	9	0	0
" 23	B	7	4	1	2
July 6	B	9	8	1	1
" 6	C	3	3	0	0
Total		36	29	2	6

†A—A cube of wood 1 mm. square.
B—A cube of phloem 1 mm. square.
C—A fragment of a recently killed needle, still in the sheath, from a "curled tip".

It should be said that some conifers other than Scots pine, in plantations adjacent to or mixed with the latter, suffered relatively slight damage from *Diplodia pinea*. One exceptional instance was observed, where small red pines became seriously diseased, although that species is highly resistant. The trees had been under-planted beneath a rather open Scots pine stand some twenty-five years old, which suffered severely from blight. They were thus exposed in the early summer to a drip of spittle from the diseased Scots pine. The infections occurring in the red pines were fairly numerous, and caused excessive resinosis, the death of some shoots, and deformation of many others; but there was no mortality, and with the disappearance of the spittle-bug overhead, the trees made a remarkable recovery.

7. EXPERIMENTAL

Inoculation experiments, in which mycelia of *Diplodia pinea* were introduced into wounds in the bark of *Pinus* species, were described by E. M. Laughton (18). *Pinus patula* suffered little effect from this treatment, but in the case of *Pinus radiata* the shoots died off above the inoculations, and to the first node below. Birch (2) found that the inoculation of three-year-old *Pinus ponderosa* in the field gave negative results. The same treatment applied to similar plants kept in shallow boxes in a humid atmosphere, resulted in the development of typical "red top". Young (32) inoculated knife wounds in small plants of *Pinus taeda*, *P. caribaea*, *P. patula*, and *P. insularis* with mycelia of *Diplodia pinea* from *Pinus radiata*. Kept inside, under highly humid conditions, the inoculated plants died; but of those left outside, some died, some suffered "die back", and some were unaffected. Crandall (5) found that three-year-old red pines (*Pinus resinosa*) were killed by *Diplodia pinea* when the fungus was introduced on rice grains inserted into slits in the bark.

In the course of our studies, a number of experimental inoculations of Scots pine were made. An account of these experiments follows:

(*a*) INOCULATIONS WITH MYCELIA

Diplodia pinea was grown on malt agar from mycelia isolated from canker lesions on blighted Scots pine. In mid-May, and again in July, small blocks of agar bearing fresh mycelia were introduced into slanting knife wounds in the bark of healthy shoots of Scots pine in the field. In some instances inoculated shoots died, but it could not be deduced from these experiments that the fungus was pathogenic.

(*b*) INOCULATIONS WITH SPORES

The inoculum used in the experiments to be described was a suspension of spores of *Diplodia pinea* in water. "Curled tips" bearing ripe pycnidia were collected and placed in a moist chamber, where sporulation began. Spores taken from the apices of the fructifications, where they accumulated, were transferred in large quantities to sterile water for use.

i. *Injection into healthy shoots*

A hypodermic needle was inserted an inch or two below the terminal buds of leading and lateral shoots on several Scots pine trees to reach the pith, and a few drops of inoculum were injected. Controls, using water only, were made on the same trees. Treated July 14th, they were re-examined October 17th.

The results are shown in Table No. 6. All of the shoots inoculated with *Diplodia pinea* became infected and developed tip blight, or its incipient condition. None of the controls developed any disease. The fungus was recovered from blighted tips.

TABLE No. 6

INOCULATION OF TIPS BY INJECTING SPORES OF *Diplodia pinea*

	No. of shoots inoculated	No. of shoots affected	
		Tip Blight (1)	Incipient Blight (2)
Tree No. 1	10	7	3
" " 2	10	9	1
" " 3	10	6	4
Control	30	0	0

(1) Tip Blight—Death of the whole shoot distally from the point of inoculation, and sometimes proximally a few inches.

(2) Incipient Tip Blight—Death of several short shoots near the point of inoculation.

ii. *Application of spores to a spittle-bug infested branch*

Early in June, 1939, a tree was chosen in a locality where no blight had been observed. It was heavily infested currently with spittle-bugs, and was known to have borne the parasites in previous years, which was evidenced, too, by the numerous stylet wounds in the twigs for several years back. The shoots of the current season were already well advanced when a branch "a" was selected for treatment. It bore several spittle masses which dripped from the 1938 internode to the one below and beyond. A concentrated spore suspension, prepared as already described, was applied with a dropper to clusters of stylet wounds along the length of the 1937 and 1938 internodes. This operation was facilitated by the use of magnifying spectacles. The branch was shaded from direct light, and was kept under observation for three days. During that time inoculation centres which threatened to become dry were moistened artifically with spittle.

In October, 1939, it was noticed that a few short shoots had died on branch "a". The following spring it was apparent that infection was spreading, and by early summer many needles were dead, and resin exuded from the bases of affected short shoots on the 1937 and 1938 internodes. By September, 1940, the branch, though still green, was badly deformed and almost girdled by active cankers. It is illustrated in Fig. 12. The three contiguous sections, a, b, c, comprise internodes of 1937 to 1940. The primary shoot of 1940, (sec. a) died early in the season from a "curled tip" infection,—the current leader originating from a secondary terminal bud. Adult spittle-bug stylet holes were found on the 1940 shoots, and there were a few ripe pycnidia of *Diplodia pinea* on the dead "curled tip". The 1939 internode had many stylet holes, some infected, others uninfected, and bore two lesions about 1/2 cm. long, which threatened to girdle the stem. The 1938 internode (sec. b) was suffering severe infection, and exhibited extensive bark lesions, resin flow, and much defoliation. Old stylet holes were very numerous. The 1937 internode (sec. c) was completely defoliated. The cambium had been killed in several places, resulting in sunken lesions and irregular branch contour. The bark was blotched with resin, and the whole distal part of the branch was threatened with death on account of girdling.

9. SUMMARY

This paper deals with a disease called *Diplodia pinea* blight of Scots pine, which in Ontario followed the invasion by that fungus of trees infested by spittle-bugs. The important literature on *Diplodia pinea* as a pathogenic agent is reviewed. A description of the fungus, and an account of its natural history are given. Observations on the pine spittle-bug and its work are recorded. The symptoms of *Diplodia pinea* blight are described, and the results of experiments relating to its cause are presented. The fungus was regularly isolated from the lesions characteristic of the disease. The injection of spores into terminal shoots of Scots pine caused tip blight. Typical crown blight symptoms followed at length the application of spores to a spittle-bug infested branch.

10. ACKNOWLEDGMENT

Acknowledgment and thanks are due the following for help received in the course of this study: Professor H. S. Jackson, University of Toronto, who placed collections in the mycological herbarium of that institution at our disposal; Professor D. H. Linder, Harvard University, for facilitating reference to works in the Farlow Library. This investigation was sponsored by the Department of Lands and Forests, Province of Ontario, Canada.

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EXPLANATION OF PLATE I

FIGS. 1-7.—The Pine Spittle-bug, *Aphrophora parallela* Say. (X-5).

FIGS. 1, 2.—Adult female.

FIGS. 3, 4.—Adult male.

FIGS. 5-7.—Nymphs.

FIG. 8.—Erumpent pycnidia of *Diplodia pinea* at the tips of needles emerging from the scales of a young short shoot of Scots pine killed by the fungus (X-10).

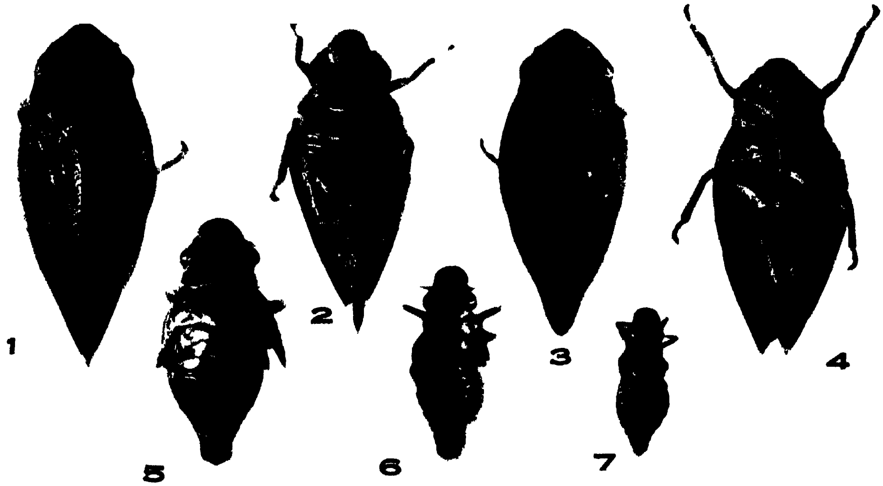
FIG. 9.—A single pycnidium of *Diplodia pinea* on a shoot of the current season. The "beak" of spores accumulated externally around the ostiole is visible (X-10).

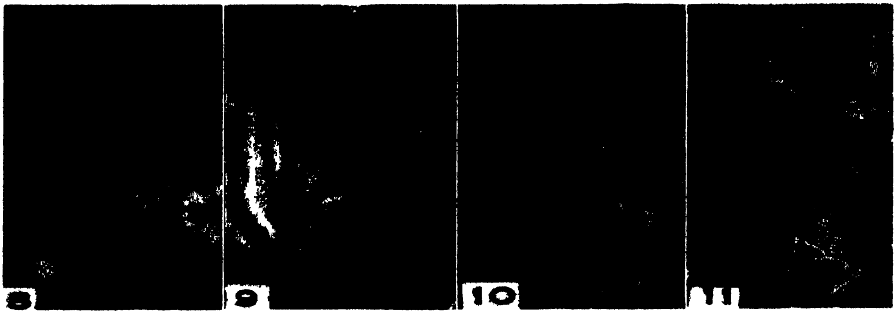
FIG. 10.—Spittle-bug stylet hole in the bark of a two-year-old internode of Scots pine (X-10).

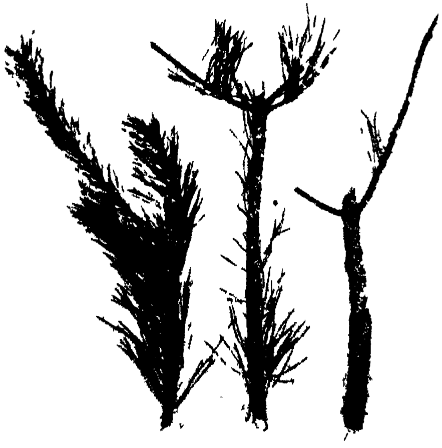
FIG. 11.—Pycnidia of *Diplodia pinea* on the trunk of Scots pine, exposed by removing the bark scales (X-20).

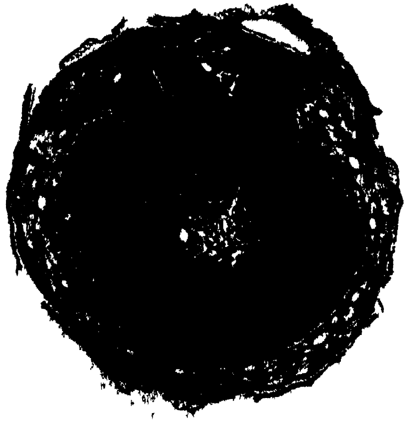
FIG. 12.—Branch of Scots pine with *Diplodia pinea* blight, following application of spores. Three contiguous sections a, b, c, are shown, comprising internodes of 1937, '38, '39, '40 (X-1/5).

FIG. 13.—Transverse section through a two-year-old internode of Scots pine, showing an adult spittle-bug stylet hole infection court. The stylet track is shown extending almost to the cambium. A "false ring" sector of traumatic xylem has been induced. The dark necrotic zone around the stylet hole is bordered by a narrow zone of phellem. This court was lightly infected by *Diplodia pinea* when examined (X-15).









HADDOW AND NEWMAN. A DISEASE OF THE SCOTS PINE (*PINUS SYLVESTRIS* L.) CAUSED BY THE FUNGUS *DIPLODIA PINEA* KICKX ASSOCIATED WITH THE PINE SPITTLE BUG (*APHROPHORA PARALLELA* SAY.)

THE BIRDS OF WOOD BUFFALO PARK AND VICINITY, NORTHERN ALBERTA AND DISTRICT OF MACKENZIE, N.W.T., CANADA[1]

By J. DEWEY SOPER

INTRODUCTION

Wood Buffalo Park was created by Order-in-Council, dated December 1922, under the Forest Reserves and Parks Act. As then established it embraced 10,500 square miles of territory west of Slave and Little Buffalo Rivers and north of Peace River. Of this, 6,875 square miles lay in northern Alberta and the remainder in the District of Mackenzie, Northwest Territories. In 1926, by arrangement with the Province of Alberta, the reservation was enlarged to include an additional 6,800 square miles south of Peace River; it now has a total area of 17,300 square miles and constitutes one of the largest big game preserves in North America. The northern boundary of the park lies 24 miles south of Great Slave Lake, Northwest Territories, and the southern extremity, 110 miles north of the end of steel at Waterways, Alberta. The area is essentially virgin wilderness throughout.

The Dominion Government decided, in 1931, to launch a faunal survey of this great area. Owing to the comparatively recent organization of the park, its vast extent, and the early problems of administration, such a task had not hitherto been attempted. The writer was assigned to this undertaking over the two-year period from early June, 1932, to late May, 1934. A main, operational base was established at park headquarters, 25 miles south of Fitzgerald; the major part of the work was conducted in far-flung sections of the territory from warden's cabins and temporary camps. Investigations were carried out over the greater part of the area at all seasons of the year. Most of the 8,000 miles of park travelling was done by means of power boats and canoes, pack and saddle horses and dog teams; an airplane reconnaissance of about 600 miles was also made a few weeks after the park was entered. As a result of the survey, 217 species of birds and 46 forms of mammals were recorded. The field notes are supported by a collection of 1,008 zoological specimens which were subsequently deposited in the permanent collection of the National Museum of Canada, Ottawa.

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[1] Contribution of the Department of Mines and Resources, Ottawa, Canada.

Four distinct planes of elevation characterize the physical geography of the territory under discussion. The highest of these is represented by Caribou and Birch Mountains—erosion plateaus of Cretaceous rock. The former is on the west with a height of about 3,400 feet above sea level and the latter on the southern boundary of the park with an elevation of approximately 2,500 feet. East and north of these, respectively, is the Alberta Plateau with an average elevation of about 1,000 feet a.s.l.; by far the greater part of the park lies within this major physiographic subdivision of the Mackenzie River Basin. The terrain is nearly everywhere gently rolling, though morainic ridges of sand and gravel occasionally attain to a height of 100 feet, or more, such as at the Ninishith Hills. Well drained uplands on the eastern side support heavy forests, here and there interrupted by small prairie openings. On the west, and particularly in the Conibear Lake basin, the land is flat and swampy with myriads of small lakes.

Immediately to the east of the Alberta Plateau is the third natural division in the relief of the area which may be known as the Salt Plains elevation. It varies in height above sea level from about 570 to 800 feet. The vegetational cover is about equally divided between dense spruce-aspen forest and large, open plains. Most of these plains support a lush growth of grasses; parts are boggy with innumerable small ponds, while other sections superficially resemble true prairie. Although in general they are poorly drained and in a measure brackish, the flats are not true salt plains and differ widely from those existing at the base of "Salt Mountain."

The lowest topographic area of the region consists of the alluvial lowlands bordering the lower Little Buffalo, Slave, Peace, and Athabaska Rivers and Claire, Mamawi, Baril, Egg and Athabaska Lakes. These lakes have a nearly common normal level of 699 feet above the sea. Most of the vast surrounding lowlands are only slightly higher and consequently subject to flooding at high water stages. The cover consists chiefly of grass, sedges and shrubbery. Of a different character are the neighbouring tracts of somewhat higher ground along the principal streams where dense forests of good quality prevail.[2]

Flora of the territory is of considerable diversity. Dense or comparatively dense forest covers the greater part. The principal trees are white and black spruce, Banksian pine, tamarack, white birch, and aspen and balsam poplar. The only deciduous trees are the four species last mentioned. As a zonal characteristic, coniferous trees are usually preëminent, imparting a decidedly boreal aspect to the country in general.

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[2] For a detailed description of the park see the author's "Wood Buffalo Park-Notes on Physical Geography of the Park and its Vicinity." Geo. Rev., July, 1939, pp. 383-399.

In some sections black spruce and tamarack swamps abound, together with open bogs and extensive muskegs grown to Labrador tea, sphagnum mosses, willows, dwarf birch and other plant life. Elsewhere are inviting, well-wooded uplands interspersed with sandy ridges grown to pine. Prairie-like tracts occur on the eastern part of the Alberta Plateau, while high grass meadows are commonest on the lower so-called Salt Plains and alluvial lowlands bordering rivers and lakes to the east and south. The park flora is now known to consist of at least 461 different plants, of which 449 are distinct species.

Since Alexander Mackenzie voyaged down Slave River on his way to the polar sea in the summer of 1789, many observers have made valuable contributions to our knowledge of the bird life in the Athabaska-Mackenzie Basin. Most notable among these is Edward A. Preble who produced his elaborate North American Fauna No. 27, in the year 1908. Ernest T. Seton (1911) added materially to this sum total as a result of his expedition through the region in 1907. Hitherto, however, the greater part of Wood Buffalo Park was zoologically unknown. Very few naturalists have worked in this precise area and faunal inquiries, almost without exception, have been of short duration. Moreover, activities of this nature were essentially confined to a few points of easy accessibility along Slave and Little Buffalo Rivers, which now represent the eastern boundary of the park. Prior to the writer's investigations no ornithologist had visited any locality contained within at least nine-tenths of the area and this is especially true of districts in the far interior.

The sequence of birds adopted in the annotated list, together with scientific and most vernacular names, follow the American Ornithologists' Union *Check-List of North American Birds*, Fourth Edition, 1931. Binomial terminology has been chiefly employed as the subspecific identity of many species has not yet been conclusively determined. In most cases this is directly owing to an insufficient number, or lack of available specimens, despite rather extensive collections. Where it has been possible to establish the geographic race with a reasonable degree of accuracy, attention is drawn to the matter under the respective specific heads.

At this point, I wish to express deep appreciation for general help received from the park staff during my two-year sojourn in the country; without the generous assistance of the wardens on numerous journeys the work could not have been so effectively carried out. To Mr. P. A. Taverner, Dominion Ornithologist, my grateful acknowledgements are also due for assistance received in the determination of numerous specimens of birds. This was a particularly valuable feature, as unfortunately the writer's official duties in the Prairie Provinces during the production of this paper rendered it impossible to study more thoroughly his material now in the National Museum, Ottawa, than was practical during field work in the north. The help in this connection also included the provision of pertinent notes and a critical reading of the manuscript.

LIFE ZONES, FAUNAL AREAS, AND LOCAL DISTRIBUTION

Biogeographically, Wood Buffalo Park occupies a relatively high boreal position. It lies entirely within the limits of what is known to zoögeographers as the Canadian Zone, in which coniferous forest predominates. The park is some 270 miles southwest of the nearest Arctic tundra, approximately 80 miles from the lower border of the Hudsonian Zone, and about 2,400 miles north of the limit of frost. The nearest approach of pure Transition Zone conditions obtains in about latitude 54 degrees, which is about 290 miles to the south. Owing in part to latitude and to the comparative proximity of the Arctic Region, the park is a land of short, warm summers and long, cold winters. Though too far south to receive the midnight sun, summer days are lengthened with twilight throughout the usual night period, and winter days are correspondingly short.

Because of prevailing physiographic factors, faunal conditions in the park are fairly uniform and homogeneous. It is far enough north to escape intrusions from the dry, central plains of the south, yet not far enough for substantial additions from the Hudsonian Zone. It is true that many species of birds here successively find their northern limits of distribution, but no abrupt changes are to be discovered in either the fauna or flora. The great majority of breeding species range throughout the length of the park. Despite the increase in latitude this relative uniformity is partly accounted for by a compensating decrease in altitude from south to north. In consequence of the successive, limiting boundaries of animal distribution, it follows that more species are to be found locally in the southern than in the northern park districts. Of the major continental biotic areas which are based on climatic conditions, that represented in this region is obviously that classified as the *Coniferous Forest Formation.*

No distinct sub-fauna is known to exist within the boundaries of the area under consideration. A possible exception may be the high plateau of Caribou Mountain, a portion of which lies in the northwestern extension of the park. At the present time its fauna is practically unknown. With its superior altitude of over 2,000 feet above Alberta Plateau, its inferentially average lower temperature and more generally depressed conditions, the fauna and flora is likely to depart materially from the common aggregate as expressed by the Canadian Zone biome of the plain below. If so, the park will then be bounded by two distinct assemblages of species and ecological characteristics differing from the intervening territory, to be known as the Caribou Plateau, and Tazin Highlands (Harper, 1931, p. 21) faunal areas, respectively. A knowledge of the park's wild life cannot be considered adequate, or complete, until Caribou Plateau has received suitable attention.

Well-marked environmental differentiations are locally exhibited throughout the region and, as elsewhere, the faunal components undergo corresponding alterations. There is, for example, a wide divergence in the character of animal life as between the great waterfowl resorts in the lake-alluvial lowlands south of Peace River and the Alberta Plateau uplands north of that stream; between the luxuriant forests along the principal rivers and the relatively lifeless pine "barrens" of the interior; and between the more richly endowed forest-prairie uplands and the muskeg belt of the western sector. In consequence of this, species which otherwise range throughout the park are diverted locally here and there into suitable ecological channels wherever they may occur. For this reason any given species with a wide range may have a notoriously local and erratic dispersion within it.

Further illustrating this condition, the following notes have been briefly drawn up: Waterfowl species chiefly met with in the lakes and sink holes of the Alberta Plateau are Mallard, Green-winged Teal, American Pintail, Ring-necked Duck, Common Loon and Horned and Holboell's Grebes. With few exceptions, and unlike conditions in the delta lowlands, they are never really abundant, or as a rule even notably common. Usually the shallow lakes and marshes of the plateau are dominated by the Common Loon and one or other, or both, of the grebes mentioned above. One of the remarkable features is the tendency of the Horned Grebe to occupy a lake to the exclusion of Holboell's, or vice versa. At Conibear Lake the Common Loon and Holboell's Grebe were found well represented, but no Horned Grebes; at Junction and other small lakes, Horned Grebes to the exclusion of all others; at "Portage Lake" (Birch River Delta), Eared Grebes held full sway with no sign of either Horned or Holboell's Grebes. In Pine Lake the Common Loon occurs with no evidence of the latter species.

Over the Alberta Plateau the Mallard and American Golden-eye are the most typical and uniformly distributed of the ducks. Most of the other species are noticeably erratic in distribution. Some one, or several of these, may be found inhabiting one stream and not another; or a species may be seen resorting to one particular stretch of a river, while it is completely absent farther up or down. Thus the Redhead, north of the Peace, was noted only on Murdock and Salt Creeks and the Lilypad and

Upper Buffalo Rivers. The Buffle-head was rather common on these streams, but was nowhere seen on Little Buffalo River. On the other hand, the Baldpate, while sparingly distributed over the plateau, is common on the latter stream in the vicinity of the Ninishith Hills, but was seen on no other part of the river. In the northern part of the park the American Coot was noted along Little Buffalo River, and at park headquarters during migration, while it occurs in considerable numbers south of the Peace (Soper, 1934). Many equally peculiar examples could be mentioned for the *Passerines*.

Several main types of park vegetation prevail, in addition to minor zonations, which bear profoundly upon local animal distribution; these express marked relationships as between the resulting habitat patterns and preference and adaptation revealed by numerous species, and are referred to as biological communities. The botanical nature of these areas, together with a few of the most characteristically associated birds, may be broadly sketched as follows:

(a) Pure Banksian pine "parklands" on sandy soil with clean needle floor, or a lichen and trailing shrub mat, occasionally relieved by copses of alder and willow. Animal life normally scarce; limited numbers of Spruce Grouse, Bohemian Waxwing, Tennessee Warbler and Chipping Sparrow.

(b) Dense white spruce forest characterized by deep moss carpet, humus, litter, and general lack of shrubbery; Solitary Sandpiper, Pileated and Three-toed Woodpeckers, Canada Jay, Hermit Thrush, Winter Wren, Myrtle Warbler, White-winged Crossbill and White-throated Sparrow.

(c) Mixed woods of poplars, birch, and white spruce interspered with glades, herb and shrub areas; some mosses, relatively deep humus and loam soil, litter and windfall; Spotted Sandpiper, Canada Goose, Red-tailed Hawk, Bald Eagle, Ruffed Grouse, Horned Owl, Flicker, Yellow-bellied Sapsucker, Phoebe, Kingbird, Crow, Black-capped and Hudsonian Chickadees, Robin, Ruby-crowned Kinglet, Blue-headed Vireo, Orange-crowned and Cape May Warblers, Redstart, Western Tanager, Olive-backed Thrush, Slate-coloured Junco, Fox, Chipping, and Song Sparrows.

(d) Pure areas of aspen or balsam poplar, or both, superficially similar to such woods in the Transition Zone; or lowlands relatively dense, with rank herb and shrub section nearly throughout, fertile loam over clay or sandy sub-soil; on rolling uplands more open with shrubs and extensive enclosed firm-turfed prairies rich in herbage of indeterminate height; Least Flycatcher, Wood Pewee, Tree Swallow, Red-eyed and Warbling Vireos, Yellow and Tennessee Warblers.

(e) Fireswept brulé lands of good drainage and impoverished soil, with sparse shrubbery, decaying windfall, and open second-growth aspen poplar stands, occasionally predominated by young Banksian pine;

Flicker, Hairy Woodpecker, Phoebe, Olive-sided Flycatcher, House Wren, Red-eyed Vireo, Yellow Warbler and Lincoln's Sparrow.

(f) Relatively barren Precambrian rock hills mantled with lichens, reindeer moss and casual tree bluffs; normally featured by rugged elevated, open areas, reduced fertility, poor scattered individuals of white and black spruce and scrub pine. Birds relatively scarce, but visited to a certain extent by species usually found in sections a, c and e.

(g) Stunted black spruce and tamarack forest, open or dense, harbouring ponds, moss and peat tussocks over cold or frozen sub-soil of poor drainage, surmounted in part by willows and depressed herbage; Alder Flyctacher, Northern Raven, Myrtle and Black-poll Warblers, American Rough-legged Hawk and Canada Jay.

(h) Open muskegs of little or no drainage with ponds and typical "quaking" bog cover of mosses and herbaceous growth, commonly associated with shrubs, and small widely-scattered black spruce and tamarack, and encircled by a marginal zone of willows, dwarf birch, etc.; Horned Grebe, Common Loon, Sora Rail, Lesser Yellow-legs, Bonaparte's Gull and Red-winged Blackbird.

(i) Upland meadows and plains of intermediate elevation and drainage, distinguished by a lush cover of grasses and sedges irregularly interspersed with shallow sloughs and random shrubs, invariably bordered by willows; Marsh Hawk, Sharp-tailed Grouse, Brown Crane, Lesser Yellow-legs, Grinnell's Water-Thrush, Western Yellow-throat, Red-winged Blackbird and Savannah, Leconte's, and Swamp Sparrows.

(j) The salt plains proper, typified by poor drainage, saline conditions, brackish water, and naked clay surface, with alternate, characteristic areas of impoverished herbage; during migration frequented by Semipalmated, Golden, and Killdeer Plovers, Pectoral and Buff-breasted Sandpipers, Horned Lark, Lapland Longspur and Snow Bunting.

(k) Lowland flood plains and delta marshes, embracing relic lakes, sluggish streams, and abandoned channel sloughs, bordered by high shrubbery and dominated by a luxuriant stand of grasses and sedges; the zonated borders of upland ponds and lakes are closely akin to this area; waterfowl of all kinds, Sora Rail, Crow, Yellow Warbler, Grinnell's Water-Thrush, Western Yellow-throat, Red-winged Blackbird, Savannah, Leconte's, and Swamp Sparrows.

As will be noted from the foregoing, numbers of birds common to the Transition Zone are widely distributed in the region, here occupying essentially similar meadows and deciduous woods as farther south. Among the most familiar of these are House Wren, Robin, Red-eyed Vireo, Least Flycatcher, Swamp, Song, and Savannah Sparrows. Though fundamentally Canadian, the park is seen, in addition, to embrace many well recognized representatives of the Transition, and to a slight degree, Hudsonian Faunas. It may be regarded in a sense, therefore, as comprising a highly composite order of wild life—a mixture far transcending that of the flanking Tazin Highlands on the east. Yet this overlapping of characteristic species from adjoining areas is everywhere present in a state of nature and not peculiar to this region. Unlike the Hudsonian, which can be considered more as a transition state between Canadian and Arctic Zones than a primary division itself (Taverner, 1916, p. 4), the Canadian Zone holds solid centres of abundance for numerous peculiar, and typical species, only a few of which are sufficiently adaptable for the occupation of more northern territory. To a degree, consequently, the park area is symbolized by the presence of species superficially regarded as more southern, while fugitive dwellers of the far north, in season, enter its more clement retreats.

An analysis of the data obtained shows, for the 217 species treated in the annotated list, the following ratio of occurrence for the various classes that reside in or visit the park, or immediate surroundings: permanent residents, 16 (7.4%); summer residents, 135 (62.5%); winter residents, 5 (2-3%): transit visitants, 34 (15.8%); accidental visitants, 26 (10.8%). A further analysis has been made of species with district occurrence in relation to their zonal distribution at the breeding season; the ratio is tabulated below for all forms listed:

Breeding birds of	Arctic Zone	26	species	12.0%
" "	Hudsonian-Arctic Zones	9	"	4.1 "
" "	Hudsonian Zone	3	"	1.4 "
" "	Canadian-Arctic Zones	9	"	4.1 "
" "	Canadian-Hudsonian Zones	33	"	15.3 "
" "	Canadian Zone	16	"	7.4 "
" "	Transition-Arctic Zones	3	"	1.4 "
" "	Transition-Hudsonian Zones	15	"	7.0 "
" "	Transition-Canadian Zones	42	"	19.5 "
" "	Austral-Arctic Zones	1	"	.5 "
" "	Austral-Hudsonian Zones	18	"	8.3 "
" "	Austral-Canadian Zones	35	"	15.8 "
" "	Austral-Transition Zones	7	"	3.2 "
Total		217	"	100.0%

The great majority of birds which occur in the Wood Buffalo Park region breed in Canadian, Canadian-Hudsonian, Transition-Canadian, and Austral to Canadian Zones. The latter class as individuals here obviously reach their northern breeding limit. The forms characteristic of these zones substantially comprise the summer breeding population of the park, representing 58.0% of the birds known to occur. It will be noted that only 16 species, or 7.4% of the whole are exclusively typical of the Canadian Zone, so that the breeding aggregate may be regarded, from a zonal viewpoint, as rather complex. The general pattern is thus less "northern" than would at first be anticipated.

As expected under prevailing conditions of distribution, Transition-Canadian species predominate with 42 members (19.5%), Austral-Canadian being next with 35 species (15.8%), and the Canadian-Hudsonian following with 33 species (15.3%). Such typically Hudsonian species as Fox and White-crowned Sparrows, Bohemian Waxwing, and Evening Grosbeak are known to breed in the park district, or occur there at the height of summer. But a conspicuous feature of bird life is the number of species woven into the avifauna of these latitudes which are so characteristic of the Transition Zone in a pure state. Hudsonian, Hudsonian-Arctic, and Arctic species are of course abundant migrants, spring or fall, or both, through the district under review.

In compiling the following check-list and data on the birds which occur in Wood Buffalo Park and vicinity, every available source of information has been tapped to provide as complete a picture of the situation as possible. While this is relatively extensive in addition to my own observations, a close study nevertheless reveals many deficiencies, for ornithological knowledge of the region, as a whole, may be properly regarded as being still in a pioneer state.

ANNOTATED LIST OF SPECIES

1. **Gavia immer** (Brünnich). COMMON LOON.

Fairly well distributed in the larger lakes, and to a lesser extent in muskeg ponds, sloughs and streams of Alberta Plateau; no particular preference is shown as between clean-shored bodies such as Pine and Buffalo Lakes and those with marshy borders as exemplified by the eastern portion of Conibear Lake. A set of two eggs collected on June 14, 1932, in a tarn near Pine Lake, was considerably incubated. On June 13, 1933, a single example was seen on Revillon Coupe—the only one noted during a month spent in the delta lowlands west to Birch River. On the 18th, two pairs with two downy young each, about ten days old, were met with in the Conibear Lake narrows. Last noted for the season on September 8, when an individual passed southward over Cherry Mountain. In the spring of 1934, it was first noted at Government Hay Camp, on May 7.

No specimens were secured for definite subspecific determination, but according to the A.O.U. Check-List, of the two races recognized, ***elasson*** is the form indicated for the region under review.

2. **Gavia adamsi** (Gray). YELLOW-BILLED LOON.

Not observed, but occurs rarely as an accidental. Preble (1908, p. 256) remarks that it is found during migration on the larger bodies of water in the interior from Lake Athabaska northward; several records are given for localities at no great distance from the park. The A.O.U. Check-List (1931, p. 2) denotes its summer range as from the Arctic coast south to Great Slave Lake.

3. **Gavia arctica** (Linnaeus). ARCTIC LOON.

This loon was not definitely identified anywhere in Wood Buffalo Park or vicinity, but it undoubtedly occurs in migration. Preble (1908, p. 257) remarks that "This species breeds commonly in the larger lakes throughout the region from Great Slave Lake northward." The A.O.U. Check-List, 1931, gives its breeding range as south to Lake Athabaska.

4. **Gavia stellata** (Pontoppidan). RED-THROATED LOON.

This species was seen nowhere in Wood Buffalo Park during the summer months, consequently it is not known to breed here, but it occurs regularly in migration. In late May, 1932 and 1933, individuals were heard loudly calling as they passed high over Slave River on the way north. A single example was noted on July 7, 1932, between Fort Resolution and Green Island, Great Slave Lake. Preble (1908, p. 258) says that it breeds abundantly from this lake northward.

5. **Colymbus grisegena** (Reinhardt). HOLBOELL'S GREBE.

Breeds in suitable places throughout the region; with few exceptions, the species is never abundant or even notably common. During June, 1933, pairs were commonly distributed in marshy ponds about Revillon Coupe and west to Mamawi and Hilda Lakes. In July, 1933, pairs were noted at several places between Pine and Conibear Lakes; at the latter place the species were observed in larger numbers than elsewhere on the Alberta Plateau, and about comparable to the best breeding resorts in the Peace-Athabaska Delta. Two nests were noted here on July 17, with two and five eggs, respectively. On July 23, four of these birds were met with on Little Buffalo River west of Ninishith Hills. In the spring of 1934, the species was first observed at park headquarters when a pair tarried there in a small pond on May 19 and 20. A few pairs breed in sloughs on the plains between Slave River and Alberta Plateau.

6. **Colymbus auritus** Linnaeus. HORNED GREBE.

Inhabits many sloughs and lakes from the Slave River plains to, and over, Alberta Plateau, where it breeds; local distribution, however, is eccentric. A set of two eggs collected at Junction Lake, July 10, 1932, was slightly incubated. In the spring of 1933, the species was first seen at Fort Smith on May 20. During June and early July it was commonly encountered in marshy ponds on the delta lowlands from Rivière des Rochers west to Birch River Delta. A mated pair was first noted at park headquarters on April 28, 1934; most common the second week of May; last seen on the 17th. During 1932 and 1933, specimens, including both sexes, were collected at Junction Lake, Fort Smith, and Hilda Lake.

7. **Colymbus nigricollis** (Heermann). EARED GREBE.

Occurs very sparingly in the park. During extensive summer travel it was never seen on Alberta Plateau. It was first observed at Portage Lake, Birch River Delta, on June 24, 1933, when 14 birds in all were noted, and two were collected. A pair was next seen near the southeast shore of Lake Claire on June 28. These were the only examples encountered during the summer. On April 27, 1934, a solitary male visited a pond at park headquarters and then disappeared; not again noted.

8. **Podilymbus podiceps** (Linnaeus). PIED-BILLED GREBE.

Apparently very rare; it was seen on only one occasion, when a pair with five downy young two or three days old, was encountered in a large marsh near the southeast shore of Lake Claire on June 29, 1933. The male was collected. Great Slave Lake appears to be the northern limit of its range; from here Preble (1908, p. 254) lists several records, and Fairbairn (1931, p. 158) noted the species at Murky Lake and Pine Point, Great Slave Lake.

9. **Pelecanus erythrorhynchos** Gmelin. WHITE PELICAN.

In July, 1932, a few individuals were seen on one of the rocky Desmaris Islands, Great Slave Lake. The northernmost known breeding colony of the region occurs on an island in the rapids of Slave River near Fort Smith. The colony was not personally visited, but numerous birds were seen flying over Slave River, southeast of Fort Smith, between May 20 and 24, 1933. They are frequently observed at the foot of the rapids near Fort Smith and at Mountain Rapid and Rapid of the Drowned. Referring to this colony Preble (1908, p. 275) says: ". . . white pelicans have evidently occupied this site from time immemorial, as Alexander MacKenzie refers to the 'Pelican' at one of the portages passed in these rapids when he descended the river in 1789."

10. **Phalacrocorax auritus** (Lesson). DOUBLE-CRESTED CORMORANT.

Not personally observed; evidently absent in the park region except for occasional migrants. It breeds in Central Alberta, and Preble (1908,

p. 274) remarks that a few stragglers have been taken about Great Slave Lake.

11. **Ardea herodias** Linnaeus. GREAT BLUE HERON.

This species has apparently been recorded from the region only by C. S. Jung (1930, p. 536); he says: "A single bird lit in a tree a few hundred yards down the river from our camp on the Quatre Fourches. We were told that the birds breed along the south shore of Lake Athabaska."

12. **Botaurus lentiginosus** (Montagu). AMERICAN BITTERN.

This species is rather commonly distributed in the marshes throughout the region, both in the flood plains of the Peace-Athabaska Delta to Birch River and Slave River, and on the Alberta Plateau. Over considerable sections, however, it appears to be rare or absent. In 1932, numerous individuals were noted northward from Mamawi Lake to Brulé Point, Slave River, but was nowhere seen in the northwestern extremity of the park about Buffalo Lake and River. In the spring of 1933, first observed at park headquarters on May 24. The species was fairly common here until September 26, followed by stragglers for ten days. One was taken on October 5. A most unusual occurrence was one lingering here at the forest margin on October 28; winter had already prevailed for some time with snow, freezing temperatures, and ice-covered ponds; the bird was evidently strong, as it rose easily above the forest and disappeared in a southerly direction.

13. **Cygnus columbianus** (Ord). WHISTLING SWAN.

During migration, these great birds regularly visit the district at the west end of Athabaska Lake. In 1932 they were first observed by Warden F. Dent at Lake Claire on April 28; at Chenal des Quatre Fourches, May 2, 1933; at Rocky Point, Peace River, April 27, 1934. Warden R. Allan informed the writer that flocks of swans comprising numerous individuals, passed over Peace Point between May 10 and 17, 1933; thay are assumed to belong to *columbianus*. On June 28, of the same year, one was personally seen on the southwest shore of Lake Claire, and another on the 30th in Mamawi Lake. Several small flocks passed southward over Slave River on September 16 and 17; on the latter date a group of three tarried for a time in a small pond west of park headquarters.

14. **Branta canadensis** (Linnaeus). CANADA GOOSE.

This is a widely distributed species, breeding locally in suitable localities throughout the park. It was first noted in the Athabaska Delta on

May 20, 1932. A pair with five downy young was seen at Salt Creek on June 3. Early in July individuals were several times met with on Buffalo River. Large numbers with well-grown young were seen on the Upper Buffalo River during the third week of the month, four being collected on the 18th. On the return trip, six were noted north of Mellor Rapids, Buffalo River, on the 26th, and a flock of ten on the 31st at Little Buffalo River above the Nyarling.

The first evidence of southward migration was noted at park headquarters on August 23, when a flock of 12 geese flew up Slave River. The passage of small, low-flying flocks, up to 18 or 20 members, was now regular until September 2, when the movement apparently ceased; but migration was resumed again between the 14th and 24th, the flocks now flying high. It is assumed that the earlier bands consisted of locally bred birds, while the later flocks aggregating 100 or more individuals and flying at upwards of 2,000 feet, were birds from more northern latitudes.

April 26, 1933, saw the earliest migrants flying north along Slave River. This movement of comparatively few individuals was irregular until May 16. By this time local birds were already nesting. At various times in June, adults were seen with immatures on the delta lowlands west to Birch River and others along the upper waters of Little Buffalo River during late July. As the year previous, small flocks began moving south in late August and early September, passing along Slave River and over the Salt Plains, followed by a quiet period; then a second pronounced movement set in about September 17, which lasted intermittently until October 3. Most of these later flocks were comparatively large, numbering up to 100 or more individuals, and flew at altitudes of 1,000 to 2,000 feet.

Warden Dent reported that the first Canada Geese observed by him in 1932, was at Lake Claire, April 12; at Chenal des Quatre Fourches, April 26, 1933; and at Rocky Point, Peace River, April 15, 1934. The first appeared at park headquarters, during the latter spring, on April 24. The extreme limits of occupation are seen to extend from early April until early October. Some of the migrating flocks, as noted above, are probably referable to *B. c. leucopareia.*

15. **Branta canadensis leucopareia** (Brandt). LESSER CANADA GOOSE.

No personal data was obtained for this race in the park, but it is undoubtedly a more or less regular migrant. Preble (1908, p. 306) saw several small geese near Chipewyan, May 15, and others at Fitzgerald, June 16, 1901, which he listed under *B. c. hutchinsi*, and which appear to be referable to this form. Likewise, Seton (1911, p. 370) saw a number of geese on October 9, 1907, among those preserved for food at Chipewyan, which he referred to ***hutchinsi***, but should now be placed under ***leucopareia***. Previous to a recent revision of the Canada Geese, the latter race was known as Hutchins's Goose.

16. **Anser albifrons** (Scopoli). WHITE-FRONTED GOOSE.

Apparently absent in the park north of Peace River, as it was never noted there during migration; it is, however, a regular migrant in the Peace-Athabaska Delta spring and fall, according to reports of hunters at Chipewyan, and information received from Warden F. C. Dent. The latter first saw the species in 1933, at Quatre Fourches, near Lake Mamawi, on May 1. In early October, 1907, Seton (1911, p. 370) saw examples in the storehouses at Chipewyan.

17. **Chen hyperborea** (Pallas). LESSER SNOW GOOSE.

During migration large numbers regularly visit the Peace-Athabaska Delta westward to Lake Claire. According to local information, heavy concentrations occur spring and fall about Mamawi Lake and the delta of Athabaska River. First geese of the season were personally observed on September 5, 1932, when during an airplane flight, a flock of 20 "snows" was seen flying over the west shore of Mamawi Lake. A flock of similar size was noted at Point Providence on October 10.

In the spring of 1933 the species was apparently absent from Slave River until a flock of 40 migrated over Fort Smith on May 22. A few straggling groups passed in late September, but the most pronounced movement set in on October 6. During the first week of the month thousands of new arrivals were reported from the west end of Athabaska Lake and vicinity. Comparison of data for the region makes it appear that the main migration route north of Athabaska Lake lies well east of Slave River; this is based partly on native statements as to the line of flight to and from Athabaska Lake, and on the fact that during the writer's sojourn no very substantial migration was seen along Slave River. In the spring of 1934, only two flocks were noted at park headquarters—on May 19 and 21, respectively. Warden Dent provided the following spring data for the first arrivals of Snow Geese: Spruce Point, Lake Claire, April 27, 1932 (last observed May 14); Chenal des Quatre Fourches, April 30, 1933; Rocky Point, Peace River, May 5, 1934.

18. **Chen caerulescens** (Linnaeus). BLUE GOOSE.

Not observed by the writer in Wood Buffalo Park. From all accounts it seems to be a comparative rarity anywhere in this region, the main flight being much farther east (Soper, 1930) from the Mississippi via southern Manitoba to Hudson Bay. Stragglers occasionally appear with

Lesser Snow Geese about the west end of Athabaska Lake. Seton (1911, p. 369) secured a recently killed specimen at Chipewyan on October 9, 1907; it was said to be the first one ever taken in the locality within the memory of any of the hunters. In 1932, Mr. K. McDonald of Chipewyan informed the writer that in the past 10 years he knew of but three Blue Geese taken here—all in the spring migration. Dr. H. W. Lewis, of Chipewyan, stated in a letter that a Blue Goose was shot in the Athabaska Delta on September 15, 1934. The residents regard these occurrences as very unusual.

19. **Chen rossi** (Cassin). ROSS'S GOOSE.

Park wardens and natives state that this species (known locally as the "galoot") is a regular spring and fall migrant to the Peace-Athabaska Delta. Two particular concentration points at this time appear to be Athabaska Delta and the southern part of Lake Mamawi. Warden Dent, who spent several years in this area, states that from the numbers of Ross's Geese observed he is of the opinion that it is more numerous than is generally supposed and that certainly many hundreds occur in migration at both the principal resorts referred to. Flocks migrate from the delta in a northeasterly direction late in May, or early in June, and are again present during the latter part of September and early October. The breeding ground of the species is now known to be near the mouth of Perry River, Queen Maud Gulf. A slightly crippled adult female, with rugose bill, was personally collected at Hilda Lake on June 29, 1933; this was the only one observed, the main flight from the region having taken place nearly a month earlier.

20. **Anas platyrhynchos** Linnaeus. COMMON MALLARD.

This is a familiar breeding duck of the region, and one of the most abundant of the resident Anatidae; it occurs in large numbers south of Peace River and is generally distributed throughout the brushy and forested areas of Alberta Plateau to the north. Summer travel disclosed an almost universal distribution along streams and in lakes and sink holes from the southern part of the park to Nyarling River and Buffalo Lake.

Well developed downy young were first seen on June 22, 1932. In 1933, the first (about a week old) were noted at Chenal des Quatre Fourches on June 16. After this date broods of six to eight were commonly met with, a feature that was particularly marked the previous July and August in the Buffalo Lake region and along Nyarling and Little Buffalo Rivers, where practically every female seen was accompanied by varying numbers of young.

Warden Dent gives the following dates for first spring arrivals: Lake

Claire, April 14, 1932; Chenal des Quatre Fourches, April 21, 1933; Rocky Point, Peace River, April 22, 1934. The species was first seen at park headquarters on May 1, 1933, immediately after the small meadow ponds were open; hundreds arrived in the next week, but numbers diminished rapidly thereafter. In the fall, Mallards were numerous here until October 10. After the ponds froze over they resorted to open stretches in Salt and Murdock Creeks, until the third week of the month. Their earliest appearances at park headquarters occurred on April 23, 1934, and in 48 hours they were very common. Specimens were collected at Buffalo River, park headquarters, and Lake Mamawi, representing spring, summer and fall birds.

21. **Chaulelasmus streperus** (Linnaeus). GADWALL.

During the park investigations this species was never seen. The A.O.U. Check-List (1931, p. 45) includes Lake Athabaska in its breeding range. Preble (1908, p. 279) says, "Macfarlane in a manuscript list states that a female gadwall was obtained at Fond du Lac, Athabaska Lake, by J. Mercredi." Occasional strays no doubt occur in the delta portion of the park, though there is apparently no definite record.

22. **Mareca americana** (Gmelin). BALDPATE.

A common breeder. It is comparatively plentiful in the marshes south of Peace River and sparingly distributed over the uplands to the north. Early in July 1932, the species was observed in numbers along Slave River to Great Slave Lake and west to the mouth of Buffalo River, but was nowhere encountered on this stream, or Buffalo Lake, and vicinity.

Mated pairs appeared at park headquarters on May 6, 1933, later became common, but disappeared about June 8. It was found fairly numerous in June nearly everywhere in the lowlands from Rochers River west to Birch River; the largest numbers resorted to Mamawi Lake and Creek and the delta of Birch River. In late July, moderate numbers were met with on Little Buffalo River from 15 miles west of Ninishith Hills to a point 20 miles below Sucker Creek. The females were almost always with broods of young numbering from five to nine. These varied greatly in age from "downies", two or three days old, up to broods fully three weeks old. A few Baldpates were present at park headquarters up to October 6. Two were seen on Slave River April 24, 1934, and shortly after the birds became fairly common in the recently opened ponds of the vicinity. The writer took specimens near Pine Lake, June 14, 1932, and at Revillon Coupe, June 13 and 14, 1933.

23. **Dafila acuta** (Vieillot). AMERICAN PINTAIL.

In many parts of the park the Pintail is almost, if not quite, as common as the Mallard; its local distribution, however, is not as uniform. Next to that species it appeared to be the most abundant of the ducks. In June, 1932, it was found sparingly in the park from Slave River and Salt Creek to Pine Lake. During July, individuals were met with at Brulé Point, Slave River; mouth of Little Buffalo River; and Lobstick Creek, but nowhere in the Buffalo Lake region. Early in August large flocks had gathered in ponds on the plain between Little Buffalo and Salt Rivers.

In 1933 the birds first appeared at park headquarters on May 1. During June and early July many thousands were seen in the lowlands from Lake Athabaska to Birch River, occasionally in large flocks. A nest found by Warden Dent at Chenal des Quatre Fourches on May 26 held ten eggs. Over large areas of the interior uplands the species is very scarce or absent. In the fall, numerous Pintails were present at park headquarters until October 8. The following spring they first appeared here on April 24, and were common in two days. Six specimens were collected at this point in May, August, and October, 1933.

24. **Nettion carolinense** (Gmelin). GREEN-WINGED TEAL.

Breeds very sparingly in parts of the Alberta Plateau but is appreciably more numerous in the lowlands west of Athabaska Lake. During the summer of 1932 the species was met with only at Murdock Creek, park headquarters, Blind Bull Lake, and Upper Buffalo River and Lake. In 1933 it was first observed at Fort Smith, May 22. Throughout the Peace-Athabaska Delta region numbers were seen almost daily, but the species was most common in Prairie River, Birch River Delta, and along the southeast shore of Lake Claire. A pair with downy young was noted on Quatre Fourches River on June 16.

On July 17 at Conibear Lake, a nest of eight eggs was found in heavy spruce-poplar forest, and three days later a female was seen at the west end with two downy juveniles only a few days old. At park headquarters it was not uncommon from late August until September 21. The following spring it appeared here first on April 26, to become fairly numerous in early May. Nine specimens in all were collected at park headquarters, Murdoch Creek, Birch River, Revillon Coupe, Fort Smith, and Buffalo River. North of Peace River distribution is very erratic.

25. **Querquedula discors** (Linnaeus). BLUE-WINGED TEAL.

A comparatively scarce bird, and aside from the lowlands south of Peace River, with a singularly "spotty" distribution. In June 1932, a few scattered pairs frequented ponds between Slave River and Pine Lake;

at the latter place a female was observed on the 9th with eight very small downy young. It was nowhere encountered in the northern park area. During June, 1933, the species was noted daily, but in small numbers and with irregular occurrence from Lake Athabaska to Birch River; maximum numbers were present in the marshes about the mouth of Birch River and along Mamawi Creek, two males having been taken in the latter place on June 21. A pair was noted at Conibear Lake on July 20; on the Alberta Plateau it is very scarce. At park headquarters it was of irregular occurrence from August to October 5, and appeared again, mated, on May 1, 1934.

26. **Spatula clypeata** (Linnaeus). SHOVELLER.

Common throughout the Peace-Athabaska marshes, but very sparingly distributed in the country to the north. During the summer of 1932 it was observed in small numbers only at park headquarters; Buffalo River (near the northern park boundary); and Buffalo Lake at Copp Creek. Hundreds of mated pairs were encountered in June, 1933, from Rivière des Rochers to Birch River. On June 29, a pair of Shovellers with five downy juveniles about a week old was noted at Hilda Lake. From early August to early September the birds were fairly numerous at park headquarters, but were not noted thereafter. They appeared again in the latter locality on April 27, 1934, and in a few days became common. In the southern park marshes this species is second in abundance only to Mallards and Pintails. Specimens were taken at park headquarters and Revillon Coupe, June and August, 1933.

27. **Aix sponsa** (Linnaeus). WOOD DUCK.

Very rare; not personally recorded. Residents commonly refer to wood ducks, but this is not to be confused with the present species, as it applies locally to the widely distributed Buffle-head, or "spirit duck." That *sponsa* occasionally occurs, however, appears evident from Preble's (1908, p. 284) report: "A duck whose description applies unquestionably to this species was examined by Reverend Mr. Warwick of Fort Chipewyan, in the summer of 1904. It had been killed in the vicinity. John Gullion, captain of the steamer *Graham*, who seemed familiar with the species, informed me that he occasionally saw it on the lower part of Peace River."

28. **Nyroca americana** (Eyton). REDHEAD.

A comparatively rare member of the avifauna. Several were observed in the lake chain immediately south of Pine Lake on June 14, 1932. On August 27, two females were taken on the east shore of Lake Mamawi.

During June, 1933, a pair was noted at Mamawi Lake and Revillon Coupe, respectively. The species has been rarely observed in the region.

29. **Nyroca collaris** (Donovan). RING-NECKED DUCK.

Rather common in some localities, but very irregularly dispersed in the region as a whole. In June, 1932, a few pairs were seen westward from Slave River to Pine Lake; near the latter an example was taken on the 14th. Later in the month it was found fairly numerous along Murdock Creek where a specimen was collected on the 22nd, and a female observed with ten downy young a few days old. On July 12, a pair was seen near Buffalo Lake. A single male appeared at park headquarters on May 4, 1934, followed by mated pairs on the 5th. In the latter part of July they were fairly common at Conibear Lake and Little Buffalo River. Several appeared at park headquarters on May 10, 1934, remained until the 15th and then withdrew.

30. **Nyroca valisineria** (Wilson). CANVAS-BACK.

The Canvas-back was not unquestionably recorded during 1932, when observations were almost wholly confined to the country north of Peace River. During June, 1933, however, it was very sparingly noted at Lake Mamawi; north and southeast shores of Lake Claire; and at Birch River Delta. Four birds of both sexes arrived at park headquarters on April 27, 1934, after which a pair was seen daily until the middle of May. One specimen was collected at Revillon Coupe on June 15, 1933.

31. **Nyroca marila** (Linnaeus). GREATER SCAUP DUCK.

Not personally identified in the park with certainty. A few thought to be this species were noted at a distance in Mamawi and Claire Lakes in June, 1933, but the demands of rapid travel, at the time, precluded delay in taking specimens for positive identification. In 1901, Preble (1908, p. 285) saw several in the marshes near the mouth of Chenal des Quatre Fourches on May 24, and at the west end of Athabaska Lake on the 31st.

32. **Nyroca affinis** (Eyton). LESSER SCAUP DUCK.

In some parts of the park, and especially south of the Peace, this species is fairly abundant. Over Alberta Plateau it is of sparing and irregular distribution. During early June, 1932, small flocks resorted to Pine Lake and the lake chain to the south. A few were seen on Murdock Creek from June 22 to 25, when a specimen was taken. A few first appeared at park headquarters on May 27, and left within a few hours. During June, 1933, the species was very common in the marshes about

Revillon Coupe and Chenal des Quatre Fourches; one was taken at the former place on the 15th. It was nowhere encountered that summer in the interior uplands north of Peace River. On May 10, 1934, a mated pair arrived at park headquarters and thereafter a few were noted daily in the sloughs until the 19th.

33. **Glaucionetta clangula** (Bonaparte). AMERICAN GOLDEN-EYE.

This is an abundant breeder in favourable localities, and distinguished, like the Mallard, for a fairly uniform distribution, both over the lowlands and the forested terrain of Alberta Plateau. During the summer it is common on nearly all the streams of the interior, plentifully accompanied by young. On June 13, 1932, flocks were seen flying north over Pine Lake at a time when the rank and file were already nesting. From this time until September the species was met with in varying abundance from Slave and Little Buffalo Rivers to Buffalo Lake. In the period from late September until October 16, many thousands were observed in various-sized "rafts" on Slave River; the lower Peace; Rivière des Rochers; and the west end of Athabaska Lake. Flocks were reported on Slave River up to November 6.

In 1933 the species first appeared along the Slave on May 1. Small flocks continued to fly north all month. During June and early July it was commonly distributed in waterways and lakes everywhere from the mouth of Peace River and Athabaska Lake to Birch River. Along this stream it was the most plentiful of ducks. The first downy young were noted in Revillon Coupe on June 16, the largest brood numbering twelve; others of eight to twelve were common on Birch River. The first 1934 appearance at park headquarters was April 25—a flock of ten composed of both sexes; small numbers resorted daily to the small ponds until May 15, and then disappeared.

34. **Charitonetta albeola** (Linnaeus). BUFFLE-HEAD.

This is another locally abundant breeder in the park territory. It is a very characteristic river species, known to residents as "wood duck." In June and July, 1932, it was fairly common on Salt and Murdock Creeks; Nyarling and Little Buffalo Rivers; Slave River and Brulé Point to Great Slave Lake; and Lilypad and Upper Buffalo Rivers. On the latter streams, in mid-July, females alone were present, commonly accompanied by young.

The first 1933 spring males arrived at Fort Smith on May 21 and increased in number for a few days before the earliest females appeared. During June the species was observed with fair regularity throughout the lowlands from Revillon Coupe to Birch River. The first brood of four downy young was noted at the latter place on June 25. A few were seen farther north at intervals until October 5. Two mated pairs arrived at park headquarters on April 27, 1934. Specimens were collected at this point and Murdock Creek.

35. **Clangula hyemalis** (Linnaeus). OLD-SQUAW.

Residents several times mentioned the occurrence of this species, but it was not personally observed. Seton (1911, p. 367) says that migrating flocks of Old-Squaws were numerous on the Athabaska River, near Athabaska Landing, on May 15 and 17, 1907, and that they were common among the ducks preserved for winter use at Chipewyan in early October of that year. In 1929, Fairbairn (1931, p. 160) found the species in active migration along the south shore of Great Slave Lake in late September.

36. **Histrionicus histrionicus** (Linnaeus). HARLEQUIN DUCK.

This beautiful species apparently occurs nowhere in the eastern or central parts of Wood Buffalo Park, but may eventually be found with some regularity in the rapid streams discharging from Birch and Caribou Mountains. The only personal record is for a full-plumaged male encountered on July 8, 1932, a few miles up Buffalo River south of Great Slave Lake. Evidently the only other record for this region is that by Preble (1908, p. 291): "Adult males roughly mounted, said to have been shot near the post, were obtained from natives at Fort Resolution in 1901 and 1903."

37. **Somateria v-nigra** Gray. PACIFIC EIDER.

A very rare straggler. Preble (1908, p. 293) writes, "Though essentially maritime, the Pacific Eider has been taken in the interior on a few occasions previous to our visits. Ross, in 1862, summed up the evidence relating to this point as follows: 'A male specimen of this very rare bird was shot by me at Fort Resolution in 1858, and a female was obtained by Mr. Alex. McKenzie in 1861 at the same place'. A specimen collected at Fort Resolution by McKenzie, probably the one referred to by Ross, is still in the National Museum." Apparently no further information has been secured since that time

38. **Somateria spectabilis** (Linnaeus). KING EIDER.

The present species, like the last, occurs only at wide intervals in this region. On October 25, 1903, Preble (1908, p. 293) took a female on the Mackenzie River at Fort Simpson, and in the summer of 1904, secured the skin of an adult male from James McKinley, of Fort Resolution; during the spring, the bird had been taken by a native somewhere on Great Slave Lake east of the post.

39. **Melanitta deglandi** (Bonaparte). WHITE-WINGED SCOTER.

Evidently of very sparing distribution in the park and vicinity. Several were seen at Blind Bull Lake, June 4, 1932, and small flocks at Pine Lake on the 4th and 5th; again at the latter place on the 14th, and the following day other birds were seen in the lake chain to the south. On July 5 a large group was noted on Slave River at Brulé Point. The bird was not observed in 1933 or 1934. Residents refer to it as the "big black duck." Preble (1908, p. 294) noted the species at many places from Athabaska to Great Slave Lakes in July 1903. In 1907, Seton (1911, p. 367) first observed the species on the lower Athabasca, June 4. Fairbairn (1931, p. 160) states that large flocks were seen on the Lower Slave in September, 1929.

40. **Melanitta perspicillata** (Linnaeus). SURF SCOTER.

The Surf Scoter was not observed in 1932, as most of the summer was spent inland where it evidently does not occur. On May 13, 1933, a single example appeared in a small pond at park headquarters with other species of waterfowl. A pair was next noted at Revillon Coupe on June 13, and a small flock at Chenal des Quatre Fourches on the 16th. Thereafter it was commonly observed in the lowlands in late June and early July from Athabaska Lake to Lake Claire. A Chipewyan resident informed us that the species, locally called "black duck", was usually common off the north shore of Athabaska Lake. Warden Dent, spring of 1934, first observed the species at Rocky Point, Peace River, on May 17.

41. **Erismatura jamaicensis** (Wilson). RUDDY DUCK.

First observed in a marsh south of Revillon Coupe on June 14, 1933, where it was fairly common and mated; the males were still engaged in their quaint antics of courtship. Two males were taken here on the 15th—the only locality in which the species was recorded for the year. First noted at park headquarters on May 12, 1934, when two mated pairs remained for a day in a small pond near Slave River. In this region the species is rare and has gone undetected by most observers. The only reference to it in the immediate vicinity is apparently that by Preble (1908, p. 297): "This species was first recorded from the region by Ross who lists it as occurring north to Great Slave Lake, and as rare. Baird, Brewer, and Ridgway state that it was found breeding near Fort Resolution by Kennicott in June, and at the same place by Lockhart, who took its eggs in July."

42. **Lophodytes cucullatus** (Linnaeus). HOODED MERGANSER.

There are no park records and undoubtedly the species is very scarce in the district. Preble (1908, p. 277) gives several records which carries its range northward to Forts Resolution, Simpson and Wrigley. Regarding its breeding range, Bent (1923, p. 30) mentions it north to, "southern Mackenzie (Great Slave Lake)."

43. **Mergus merganser** Cassin. AMERICAN MERGANSER.

The species escaped personal detection and is obviously very scarce in park and vicinity. It was seen by Preble (1908, p. 275) at the mouth of Chenal des Quatre Fourches on May 24, and at Point La Brie, 12 miles northeast of Chipewyan, on May 30 and 31, 1901. Seton (1911, p. 364) noted the species on the Lower Athabaska, June 4, and again in the delta of this river on October 11, 1907.

44. **Mergus serrator** Linnaeus. RED-BREASTED MERGANSER.

Evidently scarce in park territory and rarely recorded in the immediate vicinity by any observer. It was personally seen only in the northwest sector, where males and females were encountered at close range. A few miles north of Buffalo Lake, on Buffalo River, three were noted on July 12, 1932; two days later a pair was encountered on Buffalo Lake; and on the 18th and 22nd, respectively, single birds were tentatively recorded on Upper Buffalo River. During the last days of May 1903 it was seen by Preble (1908, p. 276) on the Lower Athabaska, and again between Fort Resolution and Fort Rae the latter part of July. Said by Fairbairn (1931, p. 160) to breed commonly on Great Slave Lake.

45. **Astur atricapillus** (Wilson). AMERICAN GOSHAWK.

A pair of breeding goshawks was observed on Upper Buffalo River July 17, 1932; the nest, containing large young, was placed in a dead, forked tree overhanging the water. An immature was taken near the 30th base line, Slave River, on August 25 and another at park headquarters on September 3. During the latter half of October individual birds were seen almost daily in this locality and about the plains to the west, where an immature was taken on November 1. Warden C. Cooper reported a Goshawk at Hay Camp in mid-December.

In 1933 the first was seen at Salt Creek on January 23, next followed by a group of four circling over the forest north of Fitzgerald on March 30 and a pair at Sucker Creek, April 1. During the next three months the species was not observed. In July, pairs, or single birds were noted at points in the far interior. A few were seen in eastern localities up to November 9. From January 20, to March 21, 1934, solitary examples were encountered at Nyarling River; Houle Lakes; Murdock Creek; Pine and Flatgrass Lakes. The species was nowhere detected during the spring.

46. **Accipiter velox** (Wilson). SHARP-SHINNED HAWK.

First noted in the park at Junction Lake June 8, 1932. Only two others were seen for the year—both near park headquarters on June 21, and August 10, respectively. The first "sharp-shins" the next spring appeared here on April 29; seven were observed during the early half of May when two specimens were taken. During the summer the species was met with at wide intervals both north and south of Peace River. A pronounced southward movement was noticeable along Slave River between August 19 and 30. Early in September two were seen between Pine and Junction Lakes. In the spring of 1934, three examples were noted at headquarters in early May. The fall migration of these hawks is much more pronounced in the eastern part of the park than during the spring.

47. **Buteo borealis** (Gmelin). RED-TAILED HAWK.

This hawk is sparingly, though rather generally, distributed throughout the territory, where it breeds regularly in heavy forest. During the summer of 1932 it was observed at intervals over the Alberta Plateau from Peace River to Great Slave Lake and west to Buffalo River. In July, the birds were common along the latter stream to latitude 59°54′ where pairs at nests in dead spruces were rather frequently encountered; several nearly black examples were noted representing the dark *harlani* phase of this species. At headquarters, typical birds were not uncommon from late August to mid-September, when a marked movement was obviously in progress. On October 7, 12, and 25, respectively, hawks in the distance, thought to be this species, flew south along Slave River.

In the spring of 1933 it was first seen on May 1, and for a week there was a perceptible movement, after which examples were only casually noted along Slave River. In June, the species was regularly in evidence throughout the country from Revillon Coupe to Birch River. A male was taken near Modere Creek on June 26; it is in typical *borealis* adult plumage except for traces of *calurus* in the well-barred thighs and suggestion of barring towards base of tail. It was observed daily from headquarters to Conibear Lake, and while descending Little Buffalo River to Lobstick Creek, July 11 to August 2. Up to September 18 the species was sparingly observed in the uplands of the central park area. In 1934 it was first seen at park headquarters on May 30. Preble (1908, p. 355) lists the "redtails" of this region under *calurus*.

48. **Buteo platypterus** (Vieillot). BROAD-WINGED HAWK.

Not personally recorded. Preble (1908, p. 237) lists the species as "apparently a regular summer inhabitant of the southern part of the Athabaska Region." Alfred E. Preble and Merrit Cary saw one on the Athabaska a few miles above Athabaska Landing on September 5, 1903. Jung (1930, p. 537) noted one flying along Chenal des Quatre Fourches in June, 1928.

49. **Buteo swainsoni** Bonaparte. SWAINSON'S HAWK.

This hawk was not personally detected; there are evidently no records extant for the park, or neighbouring territory, but from known circumstances regarding its range it is likely to occur at least casually in migration. Preble (1908, p. 356) states that the species was taken by MacFarlane at Anderson River, and the A.O.U. Check-List (1931, p. 68) includes the Yukon and Great Slave Lake in its breeding range.

50. **Buteo lagopus** (Gmelin). ROUGH-LEGGED HAWK.

This fine boreal species appears to occur but casually in this region. One was seen on the Fort Smith portage road May 25, 1932, and another on the 30th near the same place. On April 3, 1933, a single individual was seen resting on a dead spruce in a muskeg eight miles east of Ninishith Hills. Seton (1911, p. 377) observed the species at Salt River, northwest of Fort Smith, on June 25; at Slave River Delta, September 25; near Fort Smith, October 4; and near Chipewyan, October 9 and 10, 1907.

51. **Aquila chrysaëtos** (Linnaeus). GOLDEN EAGLE.

Unobserved by the writer in the park, where it is undoubtedly rare. Chief Warden M. Dempsey states that it casually occurs, having in ten years of service here observed solitary examples at Peace River and Conibear Lake. It is possibly more common farther west about Caribou Mountain. On July 10, 1901, Preble (1908, pp. 358-59) saw one at an island in Great Slave Lake 50 miles north of Fort Resolution, and another at Gros Cape on July 24, 1903. He also mentions that the bird catalogue of the U.S. National Museum lists skins received from Fort Resolution, and that J. B. Tyrrell recorded a Golden Eagle shot at Stone River, just east of Athabaska Lake, in the summer of 1892.

52. **Haliaeetus leucocephalus** (Linnaeus). BALD EAGLE.

On July 8, 1932, a single Bald Eagle was noted near the mouth of Buffalo River; on the 10th a pair was seen north of Mellor Rapids circling about a bulky nest in a spruce tree near the stream, and the following day another individual was observed a few miles south of Mellor Rapids. It was nowhere encountered on this stream southward from Buffalo Lake. Three juveniles of the species were seen in captivity at the mouth of Buffalo River on July 8, said to have been taken from a nest at the "Big Bend" of this stream about 10 days before; they were little more than half-grown and unable to fly. After this time the species was rarely observed. The remaining entries in the field books—all for solitary birds—are as follows: near Modere Creek, Birch River, June 26, 1933; Birch River Delta, June 27; 15 miles southwest of Pine Lake, July 14; and Junction Lake, September 6, 1933.

53. **Circus hudsonius** (Linnaeus). MARSH HAWK.

First noted in Nagel Channel, Slave River Delta, on July 6, 1932. On August 1 and 2, several were noted at Lobstick Creek, and on the plains east to Salt River. At park headquarters one or two daily resorted to adjacent meadows from August 16 to September 4, then disappeared, but were followed by a few individuals on September 12 and 20, respectively. The first example in 1933 appeared at headquarters on May 9. Two were seen at Fort Smith between May 18 and 20. During June it was noted in the lowlands on numerous occasions from Revillon Coupe to Birch River; in the delta lands of this stream and the southern part of Mamawi Lake it was more common than elsewhere. On July 22 one was observed at Conibear Lake. At headquarters one or two were in evidence daily from August 19 to 24. From the foregoing it is evident that the species, with rare exceptions, is confined to the alluvial lowlands.

54. **Pandion haliaëtus** (Gmelin). OSPREY.

Vague rumours were heard about the occurrence of this species in the vicinity of the park, but it was nowhere personally observed. Preble (1908, p. 366) supplies several records for Great Slave Lake and north, including two for Fort Resolution, and Seton (1911, p. 379) saw one in the Athabaska Delta on June 4, 1907.

55. **Falco peregrinus** Tunstall. DUCK HAWK.

Not positively detected in the region during 1932. One was seen near Fort Smith on May 22, 1933, and another on the 25th at park headquarters. On July 30 a pair with nest was noted in the canyon of Little Buffalo River. The next, and last for the season, appeared at headquarters at September 17 and 21, respectively. Not noted in the spring of 1934. Several pairs were seen by Williams (1922, p. 63) at the gypsum cliffs, Peace River, on May 29, 1921; of two nests, one held two large young.

56. **Falco columbarius** Linnaeus. PIGEON HAWK.

During the summer of 1932 Pigeon Hawks were many times noted between Slave River and Pine Lake, north to Great Slave Lake and west to Buffalo River. It was commonest in the latter sectors. In late August numbers appeared at headquarters, a very marked movement taking place from the 22nd to the 24th of the month. The last was noted on September 20. In the spring of 1933 it was first seen at Revillon Coupe on June 13. It was sparingly present from here to Birch River, while three were noted along Rivière des Rochers in early July. From mid-July to early August a few were in evidence almost daily between Pine and Conibear Lakes and down Little Buffalo River to Lobstick Creek. Two were noted at headquarters, Slave River, on May 2, 1934.

57. **Falco sparverius** Linnaeus. SPARROW HAWK.

This little hawk is well distributed and evidently the commonest of the raptores. In the summer of 1932 it was observed at numerous points from Peace River north to Pine Point, Great Slave Lake; along Buffalo, Nyarling, Little Buffalo, and Salt Rivers; and over the interior uplands from Pine Lake to Salt Mountain. It was particularly prevalent in mid-July along the Upper Buffalo River. At park headquarters a pronounced migration occurred from August 19 to 25; the last example was seen on September 4.

May 4 saw the first spring appearance in 1933, followed by many individuals. The first mated pair was noted May 29. Thereafter the species was observed with fair regularity along Slave River, and from Revillon Coupe to and along Birch River. In July it was found more abundant in the Alberta Plateau between Pine and Conibear Lakes and along Little Buffalo River to the falls. During August and early September the species was noted almost daily at headquarters, west to Pine Lake, and south to Cherry Mountain, where it was last seen on September 10. In 1934 the species was first observed at headquarters on May 12, but Warden Dent noted it at Rocky Point, Peace River, on May 2. Two immatures were taken at the former point on August 20 and September 3, 1932, respectively, and two adults on May 7, 1933.

58. **Canachites canadensis** (Linnaeus). SPRUCE GROUSE.

This species is a very characteristic member of the Canadian Zone fauna, but with notable irregularities of local distribution and marked cyclic periodicities of relative abundance. The park wardens stated that a peak was reached during the fall and winter of 1930-31, when literally thousands were met with on active travel, not only in favourite pine woods of the interior uplands, but in the heavy spruce forests flanking

Peace and Slave Rivers. Though still plentiful, numbers had appreciably decreased the next winter.

During the summer of 1932, the species was far from common, though in some localities in Alberta Plateau it was seen with fair regularity. Young were rarely seen; a female with five, just able to fly, was noted on July 20 at the Upper Buffalo River, and a somewhat older brood strong in flight, on the 24th. Though scarce along Slave River in June, the species became markedly more plentiful about headquarters from August 11 to September 4. A "lean" period of two weeks followed after which another wave prevailed, when the birds were common here from late September until October 17. In the interior uplands the species was observed rather commonly—sometimes a few daily for weeks—throughout the next winter. Occasionally 20 to 40 were to be seen in a day's travel, greater abundance invariably prevailing in the pine-covered uplands of Alberta Plateau.

The species was much scarcer in the summer, fall, and winter of 1933-34. Particularly in the summer it was infrequently met with; young were only once seen when a flightless brood of four, with an adult female, was noted near Pine Lake on July 13. As the previous year, only in smaller numbers, a noticeable invasion occurred along Slave River in late August and in September, examples henceforth being rarely observed. While racially a permanent resident in this region, individuals, as shown above, exhibit a distinct fall movement, but whether this is only local, or a true migration of greater extent, is not known. Some residents incline to belief in the existence of a local migration to and from Caribou Mountain influenced by the fact that Spruce Grouse are conspicuously less common during summer than fall and winter.

From June 17, 1932, to September 21, 1933, a series of 28 specimens was taken. Recent authorities, including the A.O.U. Check-List, ascribe *osgoodi* to this area. In regard to this, Mr. P. A. Taverner in a letter remarks that evidence based on the above and other specimens in the National Museum of Canada raises grave doubts as to the validity of this race. After considerable discussion of plumages he concludes by saying that "Without more evidence than is available I cannot say that the greyness of the Wood Buffalo Park birds is due to racial (*osgoodi*) difference and not seasonal. Until such evidence is forthcoming I would not care to separate them from *canradensis*."

59. **Bonasa umbellus** (Linnaeus). RUFFED GROUSE.

During better years this grouse is a common inhabitant of the forests, and though a permanent resident as a species, is much more plentiful in summer than in winter. It is evident that the birds of this latitude are in part migratory. In the summer of 1932 it was heard and seen on numerous occasions from Slave River west to various parts of Alberta Plateau. Two broods of downy young a few days old were noted on June 20. Through the fall and winter solitary birds were seen only at wide intervals; three only were encountered in December; none the next month; and but one in February. A perceptible increase was observable after March 21, 1933, but was most noticeable from mid-April to early May. The first drumming of the male was heard on May 10. During the summer and fall of 1933 the species was phenomenally scarce, as only one was observed (on June 20) at Mamawi Creek. Throughout the whole following winter only three were encountered. Six specimens were taken in March, May, August and September, 1932 and 1933, all at headquarters. These are all very grey birds. One has a slight blending of red in the tail, while in another this member is decidedly red.

60. **Lagopus lagopus** (Linnaeus). WILLOW PTARMIGAN.

A breeding bird of the Arctic Regions which invades the park in large numbers as migrants for the duration of the winter months. In 1932 it was first detected on October 21. From November 12 until April 23, 1933, flocks were commonly seen in a multitude of localities north and south of Peace River. On the latter date a pronounced migration of large, successive flocks took place over headquarters to the northeast; this course incidentally is the shortest from here to the Hudsonian Zone. The next fall, earliest arrivals from the north were noted on October 26. This winter, as in the year before, the birds were common. The last flock was noted at headquarters on April 6, 1934. Four were taken in April and November, 1933, at headquarters and Sucker Creek; all are in pure white winter plumage with the sharply black primary shafts of *lagopus*.

61. **Lagopus rupestris** (Gmelin). ROCK PTARMIGAN.

Though there are apparently no records for the park, it is to be anticipated in the northern part of the area, as Preble (1908, p. 348) mentions that the U.S. National Museum bird catalogue records skins of *rupestris* from Fort Resolution.

62. **Pedioecetes phasianellus** (Linnaeus). SHARP-TAILED GROUSE.

Individuals remain in the region throughout the year, but it is believed that the species is partially migratory. In 1932, it was first noted at Lobstick Creek on August 2 when 20 individuals in several groups were flushed on the plains; many were juveniles just capable of well-sustained flight. At various times during fall and early winter individuals or small flocks were seen on open plains to the west of Slave River. The largest flock numbered 30. On December 2 a solitary bird was flushed at Salt Creek, Mile 7, the species not to be seen again all winter. It was next observed at headquarters May 7 when a flock of seven visited the meadow and six were secured. The species was much scarcer than usual during the summer of 1933. It was noted but twice—an individual at Revillon Coupe, June 13, and a pair at the north shore of Claire Lake on the 21st, one of which was secured. A single bird was next seen at headquarters October 5, and a flock of six in a small prairie west of Little Buffalo River Canyon on January 29, 1934. Not again observed until April 28.

The 13 park specimens are all distinctly darker and more heavily and sharply marked than those from central and southern Alberta, but are identical with those from Quebec, Northern Ontario, and the Yukon. DuMont (Auk L, 1933, p. 432) proposes to revive *P. p. kennicottii* Suckley, based on two specimens from Fort Rae, Great Slave Lake; Mr. Taverner advises me that he can find no basis for this, and that he has no hesitation in referring the Wood Buffalo Park specimens to the Northern Sharp-tailed Grouse *P. p. phasianellus.*

63. **Grus canadensis** (Linnaeus). BROWN CRANE.

It is assumed to be the Little Brown Crane, *G. c. canadensis* which is a fairly common inhabitant of the lowland prairies and salt plains west of Slave River; it is decidedly scarcer in the breeding season over Alberta Plateau and the flood plains south of the Peace. In the summer of 1932 the species was frequently noted along the Slave to Great Slave Lake and in prairies flanking Nyarling and Little Buffalo Rivers and Lobstick Creek; it was most numerous in the latter locality. In July only two were seen near Buffalo Lake. In 1933 the earliest arrivals migrated over headquarters on May 7, movement continuing fairly strong for several days and chiefly in a north-northwest direction.

Warden Dent noted first spring arrivals as follows: Lake Claire, April 25, 1932; Quatre Fourches, May 2, 1933; and Rocky Point, Peace River, May 2, 1934. In the latter year it was not in evidence at headquarters until May 10, after which small flocks passed north until the 18th of the month. Unquestionable identification of park cranes awaits the collection of a suitable series of specimens; the writer was unable to collect any.

64. **Grus canadensis tabida** (Peters). SANDHILL CRANE.

There is a possibility that an occasional individual of this race ranges as far north as the region under review. In Fauna Boreali-Americana, 11, p. 373, 1831, Richardson describes a specimen under *Grus canadensis*, killed at Great Slave Lake, May 15, 1822, which from its measurements appears to be referable to the present subspecies. Specimens are required to clarify the situation; it is not yet known where in this region the Sandhill of the south meets the Little Brown Crane of the north. The distinction between them is entirely one of size, so that binocular observation alone is not applicable for certain identification.

65. **Porzana carolina** (Linnaeus). SORA RAIL.

In marshy lowland areas the Sora is not uncommon. While occurring on the Alberta Plateau, it is much less numerous than in marshes of the flood plains adjacent to Slave River, and in the Peace-Athabaska Delta. During the investigations it was detected in various marshes from the southern end of the park north to Nyarling River and west to Conibear Lake. In particular, it was found abundant in marshes from Revillon Coupe west to Birch River, where often their familiar high-pitched cries were heard on every side. At headquarters the species was common from August 9 to 24, 1933, indicating an influx at this time, as the birds were apparently absent here earlier in the season. Three female immatures were taken here on August 12 and 18, respectively.

66. **Coturnicops noveboracensis** (Gmelin). YELLOW RAIL.

While canoeing along the Little Buffalo River in late July, 1932, notes of a Rail, thought to be this species, were heard in two separate marshes between Sass and Nyarling Rivers. Preble (1908, p. 314) noted one Yellow Rail on July 17, in the Slave River Delta, while Seton (1911, p. 372) remarks, "We did not actually see this secretive species but heard its unmistakable notes in the extensive marsh bordering Salt River, a few miles above its mouth, on the evening of June 24."

67. **Fulica americana** Gmelin. AMERICAN COOT.

In July, 1932, observed on several occasions at Nyarling River, and along the Little Buffalo south to Sass River. During June, 1933, the species was found commonly distributed throughout the marshlands from the Rocher River to Birch River Delta. A male was taken at Revillon Coupe on June 13. On the 21st several nests were found in a marsh bordering Mamawi Creek; in two of these the chicks were just hatched; two others held three eggs each, and a youngster fresh from the shell. Six downy young deserted the fifth nest as the canoe approached. A set of five eggs was taken on June 29 in a marsh south of Hilda Lake. The last example of the season was seen near Murdock Creek on October 5. Warden Dent stated that his first record, in 1933, was at Chenal des Quatre Fourches on April 29.

68. **Charadrius semipalmatus** Bonaparte. SEMIPALMATED PLOVER.

A small flock of these little plovers was seen on the beach at Fort Resolution on July 27, 1932, and the next day a few individuals near the same place; these were the only ones noted that year. It was frequently seen at the Slave River headquarters from August 7 to 29, 1933, and an adult and juvenile, each, was secured on the 12th and 24th, respectively. A flock of twelve birds visited the Hay Camp meadow on May 21, 1934.

69. **Oxyechus vociferus** (Linnaeus). KILLDEER PLOVER.

Occurs regularly and breeds sparingly in at least the lower lands adjacent to the Peace-Athabaska Delta and along Slave River to Great Slave Lake. The species appears to be nearly absent from the uplands of Alberta Plateau, as the only ones ever noted there were solitary birds at Pine and Junction Lakes June, 1932. In 1933 it was first seen at headquarters on May 3. During June, individuals or pairs were infrequently met with from Revillon Coupe to Spruce Point, Lake Clair; two lone examples were noted in July along Rocher and Upper Slave Rivers, respectively. At headquarters two or three were seen daily from August 8 to 14, where it first appeared again on May 12, 1934.

70. **Pluvialis dominica** (Müller). AMERICAN GOLDEN PLOVER.

Warden Cooper observed this species at park headquarters about May 10, 1932; its presence in migration appears to be very irregular along Slave River. The writer first encountered the species on September 3, 1933, on the Salt Plain west of Fort Smith where a juvenile male was taken. During the next two days several small flocks were seen in the same place. One was noted at Cherry Mountain September 8, and flocks composed of fifteen and eight birds appeared at headquarters on the 16th and 17th of the month. Seton (1911, p. 374) saw a few in the Athabaska Delta on October 10, 1907.

71. **Squatarola squatarola** (Linnaeus). BLACK-BELLIED PLOVER.

This species escaped personal observation. In the spring of 1901, Preble (1908, p. 332) noted it only at Chenal des Quatre Fourches, near Chipewyan, where a small flock was seen on May 23; he remarks that Russell took one at Chipewyan on June 8, 1893. Fairbairn (1931, p. 161) states that juveniles were common at Fort Resolution in September.

72. **Arenaria interpres** (Linnaeus). RUDDY TURNSTONE.

Small flocks were seen on migration along the east shore of Mamawi Lake on June 10, 11, and 12, associating with Least, Pectoral, and Buff-breasted Sandpipers. Along the north shore of Lake Athabaska, northwest of Chipewyan, Preble (1908, pp. 335-6) saw several small companies on May 25, 1901; he notes that Kennicott took a specimen at Fort Resolution on June 1, 1860.

73. **Capella delicata** (Ord). WILSON'S SNIPE.

A regular and fairly common inhabitant of the park. In late June, 1932, numbers were seen and heard daily along Murdock Creek. One noted at Buffalo Lake July 15, and a flock of twelve was flushed from a meadow near the junction of Nyarling and Little Buffalo Rivers on the 29th; two were seen at Sass River the next day, and one at Lobstick Creek, August 1.

First noted at headquarters May 4, 1933, where it was present daily until the 10th. In June the species was common in the lowlands from Lake Athabaska to Birch River, and in July it was seen at long intervals west from Slave River to Conibear Lake and down Little Buffalo River to Lobstick Creek. At headquarters the species was fairly plentiful from August 9 to 23, when four examples were collected. It was last observed at Cherry Mountain on September 9th. In 1934, the first was detected at headquarters on May 9. Even under essentially comparable meadow conditions on Alberta Plateau, the species is much less numerous there than on lake and river lowlands to the east.

74. **Bartramia longicauda** (Bechstein). UPLAND PLOVER.

On June 21, 1901, Preble (1908, p. 328) collected a female at Fort Smith and on the 24th secured a male in a prairie several miles to the west. It is undoubtedly very rare. The nearest breeding record is that by Randall (1933, p. 3) not far from the town of Athabaska.

75. **Actitis macularia** (Linnaeus). SPOTTED SANDPIPER.

This is the commonest and most characteristic sandpiper of the region and occurs alike along all streams of the lowlands and on Alberta Plateau. It was found in abundance from the Peace-Athabaska Delta region north through all territory visited to Buffalo and Great Slave Lakes, being most numerous along Birch, Little Buffalo, and Upper Buffalo Rivers. In the spring of 1933 it was first noted on Slave River, May 19. Three nests of four eggs each were found on a sandy beach at Spruce Point, Lake Claire, between June 21 and 23. Preble (1908, p. 329) saw nests on a sandy island 25 miles below the Peace as early as June 8. In both 1932 and 1933 the last Spotted Sandpipers were seen on August 30. The 1934 spring arrival date for Slave River was precisely the same as the preceding season.

76. **Tringa solitaria** (Wilson). SOLITARY SANDPIPER.

Though, on the whole, a tolerably common breeder in this territory, it is apparently absent or rare in many sections, while elsewhere it may be locally numerous. In the summers of 1932 and 1933 it was observed sparingly south of the Peace and from Slave River west to Pine and Conibear Lakes; it was comparatively common along Upper Buffalo, Lilypad, Copp, Nyarling, and Little Buffalo Rivers. On the latter stream the species was flocking during the last days of July, 1932, the majority of individuals being juveniles. In 1933 the last was noted at headquarters August 24. Specimens were of prime importance to determine the comparative ranges of eastern and western forms; six were taken between June 20 and July 25, 1933, at Mamawi Creek, Conibear Lake, and Sucker Creek. The three individuals of July 25 are distinctly juvenile and not full grown. All specimens are relatively small, lack marblings on any of the wings, and the spotting on the backs of juveniles is not buffy. All are therefore clearly referable to typical *solitaria* without any suggestion of *cinnamomea*.

77. **Totanus melanoleucus** (Gmelin). GREATER YELLOW-LEGS.

Occurs casually in migration to Great Slave Lake; though carefully searched for, it was not personally detected. On May 16, 1904, Preble (1908, p. 326) took a male from among a flock of Lesser Yellow-legs at Fort Simpson; the U.S. National Museum catalogue shows that specimens were received from Big Island and Fort Resolution. Five were noted by Williams (1933, p. 27) near Fitzgerald, Slave River, September 20, 1922.

78. **Totanus flavipes** (Gmelin). LESSER YELLOW-LEGS.

Breeds plentifully, with good distribution alike over the lowlands and Alberta Plateau, though preference is shown for the grassy plains immediately east of the escarpment. In brief, the species was noted in practically all territory covered in the summers of 1932 and 1933 from the lake lowlands south of the Peace to Great Slave and Buffalo Lakes. In late July and early August the birds were especially common along Little Buffalo River, and on the Lobstick Creek plains, already gathered in flocks of 15 to 20 individuals. Not seen after the second week of August. In 1933 it was first noted at headquarters on April 30; large numbers visited the local meadows from early August until the middle, the last observed being on the 22nd. The following spring, earliest arrivals appeared on April 28, with increasing numbers until the middle of May. Eight specimens were collected at headquarters and Heart Lake.

79. **Pisobia melanotos** (Vieillot). PECTORAL SANDPIPER.

A not uncommon migrant. The first were met with on June 10, 1933, on the west shore of Mamawi Lake, where they were flocked in moderate numbers with Least and Buff-breasted Sandpipers. At headquarters meadow the species was fairly common from August 10 until early September when a male and female were taken; numbers then gradually diminished until the last was noted on the 24th. In the spring of 1934 a flock of ten individuals was seen here on May 20—the first and last encountered.

80. **Pisobia fuscicollis** (Vieillot). WHITE-RUMPED SANDPIPER.

Not personally recorded; undoubtedly a rare migrant in this region. Preble (1908, p. 321) mentions that a specimen was taken by Kennicott at Fort Resolution on May 19, 1860. Seton (1911, p. 373) observed a single individual below Point Brulé, Slave River, October 1, 1907.

81. **Pisobia bairdi** (Coues). BAIRD'S SANDPIPER.

In 1901 this species was seen by Preble (1908, p. 321) at a Chenal des Quatre Fourches marsh near Chipewyan on May 24; the next day several large flocks were noted between the latter point and Point la Brie, Lake Athabaska. He noted a flock at the Athabaska Delta on June 1, 1903, and a few at Fort Resolution, July 13, which probably signified the beginning of the southward migration from the Arctic tundra. Alfred Preble and Merritt Cary saw a small flock at Athabaska Delta, August 4.

82. **Pisobia minutilla** (Vieillot). LEAST SANDPIPER.

Rather large mixed flocks of this species, Pectoral, and Buff-breasted Sandpipers were observed along the east shore of Mamawi Lake on June 10, 11, and 12, 1933. On the southward flight they first appeared at headquarters on August 10 and in moderate abundance, intimately associated with large flocks of Semipalmated Sandpipers; this continued until the 22nd when all disappeared. Juveniles were collected on the 12th and 19th. A small flock, tentatively recorded under *minutilla*, briefly tarried at headquarters on May 20, 1934.

83. **Limnodromus griseus** (Gmelin). DOWITCHER.

Not encountered in 1932, nor in the spring and summer of 1933, until August 10, when a few appeared at headquarters coincident with the first southward migration of Pectoral and Least Sandpipers. Dowitchers were apparently present here for only three days, that is, until August 12, after which examples were not again detected, though some other waders, including Wilson's Snipe, increased in numbers.

Only a single specimen was secured—a juvenile of uncertain sex taken August 12, 1933, at park headquarters; the bill is 55 mm. in length. Owing to the uncertainty of the sex the subspecies is in question, but it appears referable to the short-billed race, and in all probability belongs to ***hendersoni*** (Rowan, 1932, p. 26), which is apparently a good subspecies described since the publication of the 1931 A.O.U. Check-List. Taverner and Sutton (1934, p. 45), on the basis of their Churchill, and other available specimens, express themselves as inclined to accept ***hendersoni*** as a valid subspecies. Judging from available literature, it appears that Dowitchers have rather rarely been seen in the Athabaska-Great Slave Lakes region, and none hitherto for Wood Buffalo Park. Preble (1908, p. 319), under *scolopaceus*, says that specimens have been recorded by various authors from points about Great Slave Lake north to Fort Norman and Anderson River.

84. **Micropalama himantopus** (Bonaparte). STILT SANDPIPER.

Apparently a migrant in the region under review, but not observed by Preble, Seton, or the writer. Preble (1908, p. 319) writes that Ross recorded the species as having been taken at Fort Resolution, May 19, 1860, and that Russell secured specimens at Chipewyan, June 6 and 12, 1893.

85. **Ereunetes pusillus** (Linnaeus). SEMIPALMATED SANDPIPER.

Provisionally recorded in flocks of Least and Pectoral Sandpipers, east shore of Mamawi Lake, on June 10, 11, and 12, 1933. On August 9 the species suddenly became common enough in large flocks at Hay Camp meadows (Slave River) and continued so until the third week of the month; numbers then rapidly diminished, with the last recorded on the 28th. In 1934 it was first noted at headquarters May 20, represented by a flock of about 150 individuals. The birds were still common there when the writer left the park on the 22nd. Nine specimens were taken here between August 12 and 19, 1933, all of which prove to be juvenile birds of the year. The species was noted by Preble (1908, pp. 323-4) at Chenal des Quatre Fourches, May 24, 1901, while the first wave of southbound migrants was observed at Fort Resolution, July 13, 1903. Seton (1911, p. 373) saw the species at the latter place on July 17, 1907.

86. **Tryngites subruficollis** (Vieillot). BUFF-BREASTED SANDPIPER.

Several were noted in flocks of Least and Pectoral Sandpipers at Lake Mamawi, June 10 and 11, 1933. Not again observed until September 5, when at the Salt Mountain Plain, near the salt springs, a juvenile was collected from a flock of Pectoral Sandpipers. During his investigations, Preble met with the species but once when several were noted in a Quatre Fourches marsh on May 24, 1901. The species appears to be a relatively rare migrant in the park region. It is the writer's impression that the majority of shore birds, like Arctic-breeding geese, follow a route in migration to and from this locality mostly east of Slave River.

87. **Crocethia alba** (Pallas) SANDERLING.

Breeds far to the north and is seldom observed in migration in the park region. Preble (1908, p. 325) gives several records for Great Slave Lake and adjoining territory, with one for Chipewyan, where Russell took a specimen on June 7, 1893. Fairbairn (1931, p. 160) saw a small flock near Stony Island, Great Slave Lake, in September, 1929. A flock, though to be Sanderlings, was noted by Williams (1933, p. 27) at Resolution, September 13, 1922.

88. **Recurvirostra americana** Gmelin. AVOCET.

Preble (1908, p. 317) records two specimens from Chipewyan lodged in the museum at Fort Simpson, and that the U.S. National Museum lists two specimens from Fort Rae, two from Peace River, and one from Fort Resolution, the latter collected June 1, 1864.

89. **Steganopus tricolor** Vieillot. WILSON'S PHALAROPE.

Not personally seen or collected. Apparently the only published record for the district is a male collected by Jung (1930, p. 536) on the east shore of Lake Claire, June 11, 1928.

90. **Lobipes lobatus** (Linnaeus). NORTHERN PHALAROPE.

Observed on only one occasion; a small flock appeared at headquarters on August 10, 1933, coincident with the arrival of several species of *Scolopacidae*, where it tarried for three days and then disappeared. One was seen by Preble (1908, p. 316) near Desmarais Islands, Great Slave Lake, July 29, 1904.

91. **Stercorarius pomarinus** (Temminck). POMARINE JAEGER.

Several records are given by Preble (1908, p. 260) for Great Slave Lake. Seton (1911, p. 360) saw four in the Athabaska Delta on June 4, 1907. One was noted by Fairbairn (1931, p. 160) at Fort Resolution, June 1929.

92. **Stercorarius parasiticus** (Linnaeus). PARASITIC JAEGER.

This is the common jaeger of the region about Great Slave Lake and north. On July 7, 1932, several were met with west of Fort Resolution via Green Island en route to Buffalo River; another was observed off Pine Point, Great Slave Lake, on July 27. There are evidently no records extant for the park territory.

93. **Stercorarius longicaudus** Vieillot. LONG-TAILED JAEGER.

On June 13, 1933, a solitary example of this locally rare species was seen resting on the water at the extreme northwestern end of Lake Athabaska near the head of Rivière des Rochers. This is apparently the only record for the park locality. Preble (1908, p. 262) gives a number of records for nearby Great Slave Lake.

94. **Larus argentatus** Pontoppidan. HERRING GULL.

This is a locally abundant breeding bird. In 1932 it was noted at frequent intervals in many localities north to Great Slave Lake where it was common along the south shore from Fort Resolution to Buffalo River. At the mouth of the latter, a flock of about 300 was present on July 8, attracted by offal from fishing operations for the abundant inconnu, or coney. It was only sparingly in evidence at Buffalo Lake and for the entire length of Buffalo River. In 1933 it first appeared along Slave River on April 23. Moderate numbers only were seen in June from Rivière des Rochers west to Birch River. The same condition applied to the country traversed in July, via Pine Lake to Conibear Lake, and on the descent of Little Buffalo River to Lobstick Creek. It was in greater evidence at Salt River Settlement. The last were noted along Slave River about the middle of August. In 1934 first individuals were seen on Slave River April 24.

95. **Larus californicus** Lawrence. CALIFORNIA GULL.

A number of gulls referred to this species was noted on the Lower Slave Lake above Nagel Channel in early July 1, 1932. It was commonly in evidence from Fort Resolution west via Green Island, Ile du Mort, and Sulphur Point to Buffalo River. On July 14 a flock of 30 was observed on a sand spit at Buffalo Lake associated with Bonaparte's Gulls and Common Terns. Other groups were encountered along the east shore of the lake, near Copp Creek, on the 23rd and 24th of the month. The California Gull has been observed and collected by several naturalists in this region.

96. **Larus delawarensis** Ord. RING-BILLED GULL.

This gull was not personally and unquestionably seen in park or vicinity. It appears to have been noted by very few observers and is doubtless comparatively rare. While at Chipewyan, Preble (1908, p.

267) saw a few on June 3 and 4, 1903, and again near Fitzgerald on the 10th; he states that Russell took an adult at Chipewyan in the spring of 1893 and that Baird, Brewer, and Ridgway record eggs of the "ring-bill" from Great Slave Lake; two were seen at Desmarais Islands, July 1, 1903, by A. E. Preble and Merritt Cary.

97. **Larus canus** Richardson. SHORT-BILLED GULL.

Observed daily, May 18 to 22, 1932, from Athabaska Delta north along Rocher and Slave Rivers to Fitzgerald. At Fort Smith it was common during the last week of the month, and in June was many times encountered along Slave River and west to Pine Lake; at the latter place a specimen was taken on June 6. Late in the month at Fort Smith, a flock of 30 to 40 birds was seen daily feeding on insects in vacant lots and pastures about the settlement. The species is said to breed freely about the nearby rapids in Slave River. In early July it was frequently observed along the south shore of Great Slave Lake.

The birds appeared at headquarters early in May, 1933, where they soon became common. Two adult males were taken here on June 2. In 1934 the species appeared along Slave River on May 1, at first sparingly, but in a few days it was much more plentiful than the previous year. An adult male and female were collected on the 2nd. Bent (1921, p. 145) records its breeding at Lake Athabaska.

98. **Larus pipixcan** Wagler. FRANKLIN'S GULL.

First observed at Mamawi Lake on June 10, 1933. During the next two weeks many individuals and several small flocks were met with from Rivière des Rochers west via Mamawi and Claire Lakes to Birch River Delta. On June 29 a breeding colony of about 400 birds was located in a marsh near the southeast shore of Lake Claire south of Hilda Lake. The birds were industriously building nests in the water among the rushes and sedges; these were in all stages of construction, while a few, completed, held one to three eggs. Two adult males in full plumage were taken at this point. A large breeding colony of these gulls was reported by natives as existing west of Chenal des Quatre Fourches north of Lake Mamawi. The species was not observed elsewhere in the park. The above represents the extreme northern limit of its known breeding range which is apparently the northernmost nesting locality on record. Preble does not list the species. Jung (1930, p. 534) records it at Lake Claire, June, 1928—the only other undoubted record for the district.

99. **Larus philadelphia** (Ord). BONAPARTE'S GULL.

This little gull is much more characteristic of the region than the preceding species, though the latter appears to entirely supplant it in the southeast part of the park during the breeding season. Early in June, 1932, *philadelphia* was casually met with from Slave River to Pine Lake (where an adult was taken on the 14th), and a flock of six was noted at Murdock Creek on June 22. A flock of 20 individuals was encountered at Buffalo Lake on July 14. On July 29 a few casuals were noted at Nyarling River. A number of stragglers passed down Slave River at headquarters on June 2, 1933. In late June several were noted at Birch River below Alice Creek. On July 20 and 21 it was found common at the west end of Conibear Lake—an obvious nesting area—where numerous juveniles were in flight with the adults. In 1934 the first spring arrivals appeared at headquarters on May 10; on the 12th the birds were common but all withdrew on the 15th. Bent (1921, p. 179) says that it is known to breed at only a few localities in the timbered regions of the northwest, among these being at Forts Rae and Resolution, Great Slave Lake.

100. **Sterna hirundo** Linnaeus. COMMON TERN.

Only irregularly observed anywhere north of Peace River. Several small flocks occurred at Buffalo Lake on July 14 and 23, 1932; a small group was seen near Dawson Landing, Great Slave Lake, on the 27th; and another at Lake Mamawi, August 27. Late in June, 1933, it was observed almost daily from Prairie River to Birch River Delta, where it was common, as well as at the southeast shore of Lake Claire, south of Buffalo Point, on July 29, when an adult was taken out of a company of Franklin's Gulls. Two were noted at Rivière des Rochers, July 1, and several at the west end of Conibear Lake on the 20th. Preble (1908, p. 272) saw the species at Athabaska and Great Slave Lakes, and Jung (1930, p. 535) along the west shore of Lake Claire.

101. **Sterna paradisaea** Brunnich. ARCTIC TERN.

On May 21 and 22, 1932, a few were noted in the Athabaska Delta and in the lake approaching the entrance to Rivière des Rochers. Numbers were met with near the mouth of the Slave below Jean River and at the delta marsh of Nagel Channel, July 6. On the following day a few stragglers were seen in the vicinity of Burnt and Green Islands, Great Slave Lake. On July 3, 1901, Preble (1908, p. 272) found the species nesting on low, sandy islands above the delta of Slave River, and again at Loon Island, 50 miles north of Fort Resolution, July 11 to 14, when most of the eggs were hatched.

102. **Hydroprogne caspia** (Pallas). CASPIAN TERN.

Several noted in the Athabaska Delta May 22, 1932, and two on Nagel Channel, near Fort Resolution, on July 6. A solitary example was encountered near Buffalo Point, Lake Claire, on June 28, 1933—the only one noted for the entire season. From June 20 to July 17, 1903, Preble (1908, p. 271) frequently saw the species at Fort Resolution. In 1907 Seton (1911, p. 362) recorded the bird only at Athabaska Delta, June 4. Bent (1921, p. 210) specifically mentions Fort Rae, Great Slave Lake, within its breeding range.

103. **Chlidonias nigra** (Gmelin). BLACK TERN.

A relatively common breeding bird throughout the territory north to Great Slave Lake, though it is much less numerous on Alberta Plateau than in the Peace-Athabaska-Slave River lowlands. In June and July, 1932, it was noted at numerous points from headquarters west to Pine Lake; at Murdock Creek; Brulé Point; Slave River Delta; Buffalo Lake (common in the marshes about the mouths of Upper Buffalo and Lilypad Rivers, and Copp Creek) and Nyarling and Little Buffalo Rivers. In early August large numbers were noted in a marsh opposite Le Grand Detour and over the plain between Lobstick Creek and Salt River. Spring arrival here is about May 20. The species is a prolific breeder in the marshy lowlands from Lake Athabaska to Birch River. On June 21, 1933, large numbers with nests were found at the mouth of Mamawi Creek when the young were just hatching. From July 13 to 22 a few were noted along the Conibear Lake trail, at this lake, and along Little Buffalo River.

104. **Zenaidura macroura** (Linneaus) MOURNING DOVE.

A very rare species which was not personally recorded. Anderson (1913, p. 477) lists it with the following remarks: "Mr. Harry Jones informed me that a pair was seen and one secured at Hay River, Great Slave Lake, June 13th, 1908; very rare, and the species unknown to the natives there." Jung (1930, p. 537) records seeing one on June 11, 1928, along a path at Chipewyan, Lake Athabaska.

105. **Bubo virginianus** (Gmelin). GREAT HORNED OWL.

A common inhabitant of the deep forests everywhere throughout the park where it breeds in abundance and remains throughout the year. Larger apparent numbers in winter bear out Preble's (1908, p. 372) statement: ". . . It is to some extent migratory, retiring in winter from the northern portion of its range, and then becoming much more abundant than in summer over the region southward from Great Slave Lake."

While canoeing along streams in 1932 and 1933, large numbers were noted with well-grown young, a marked abundance being particularly in evidence along Upper Buffalo, Lilypad, Little Buffalo, Nyarling, and

Birch Rivers, and Salt and Murdock Creeks. From June to August the majority of birds encountered are flying submature birds of the year. One taken at Salt Creek, June 17, 1932, was about half-grown and capable of flight. Throughout the winter the birds are frequently flushed along the trails, while their deep, mournful hooting is to be heard in the spruces at every night camp. On March 18, 1934, a nest was found in a dead tamarack west of Ninishith Hills; when the owl deserted, a Canada Jay promptly pre-empted the nest and apparently began devouring the eggs; this could not be checked as the tree was unsafe to climb.

Six adult specimens of both sexes were taken at headquarters from October, 1932, to April, 1934. The birds are consistently light-coloured. A female collected May 11, 1933, is undoubtedly a breeding bird as indicated by a large brood patch on the abdomen; that this specimen (No. 3004) is the darkest of the lot is only a coincidence, as very light adults, with young, were frequently observed in mid-summer along waterways mentioned above. Mr. Taverner writes that in the National Museum is a specimen (No. 35854) from the mouth of the Mackenzie, which is exactly similar to No. 3004. He says, furthermore, that the park specimens blend perfectly into specimens from the southern part of the Prairie Provinces, cannot be separated from them, and are unhesitatingly referable to *subarcticus*. Only one (2648, Hay Camp, Oct. 27, 1932) shows any pronounced tendency towards buffy underplumage.

106. **Nyctea nyctea** (Linnaeus). SNOWY OWL.

Though evidently a more or less regular migrant from higher latitudes to the territory under review, the flight is more pronounced some winters than others. During the park investigations few were seen and these were confined to the winter of 1933-1934. One was noted October 15, 1933, on the plain west of La Butte, and two on March 2, 1934, in a wide prairie 28 miles southwest of Fitzgerald. Warden reports similarity indicated a scarcity of Snowy Owls throughout the country during both winters.

107. **Surnia ulula** (Linnaeus). HAWK OWL.

This diurnal owl is only moderately common in the park—more numerous spring and fall; it was absent from late December until early April. In June 1932 it was only once encountered, when a male was collected at Murdock Creek on the 24th. Next observed October 19. Specimens were taken at headquarters on October 27; November 25; and December 4. One was reported here on December 22. A male was collected at Flatgrass Lake, April 1, 1933. From now until April 22 only four were observed, and a female was taken at headquarters on the latter date.

This was the last met with until October 15 when a female was secured 15 miles south of La Butte.

108. **Scotiaptex nebulosa** (Forster). GREAT GRAY OWL.

Relatively scarce; occurs chiefly as a migrant from the Hudsonian Zone during the colder months. An individual observed at Lilypad River (near Buffalo Lake) on July 15, 1932, suggests that it breeds in small numbers at least in the northern part of the park. At headquarters one was seen on December 30, and a female collected on January 14, 1933; its stomach was filled with the remains of Red-backed Mice which were very plentiful at this time. For the remainder of the season records for solitary birds were as follows: Salt Creek, January 23; Lake Six, February 1; west of Fort Smith (dead beside the trail), March 31; Flatgrass Lake, April 1; Sucker Creek, April 5. Not observed during the winter and spring of 1933-34.

109. **Asio wilsonianus** (Lesson). LONG-EARED OWL.

Inferentially a migrant through the park territory, though not noted by the writer. Preble (1908, p. 367) took a male at Fort Simpson, May 10, 1904, and gives other records as follows: Egg secured by Ross, Fort Simpson, May 1; McFarlane states that two eggs were taken by an Indian at Fort Providence, April 14, 1885, and a female was obtained at Fond du Lac, Athabaska Lake, the same season.

110. **Asio flammeus** (Pontoppidan). SHORT-EARED OWL.

Very sparingly distributed. First observed at park headquarters August 12, 1932; from one to four frequented the meadow almost daily until the 23rd and then disappeared. A female was secured on the latter date. One was encountered at close range on the open plain east of Lobstick Creek on August 2, 1933. Preble (1908, p. 367-8) observed a single bird at Chenal des Quatre Fourches on May 24, 1901; it is also recorded at several points on Great Slave Lake and Fort Simpson (Fairbairn, 1931, p. 161 and Williams, 1933, p. 27).

111. **Cryptoglaux funerea** (Linnaeus). RICHARDSON'S OWL.

One observed at headquarters August 30, 1932, and a male taken at the same place on March 15, 1933. The bird is obviously scarce, as these comprise the only personal records. Judging from the literature, the species has escaped observation by most naturalists who have passed through this region. On June 7, 1901, Preble (1908, p. 370) found a nest containing three nearly fledged young 10 miles below the mouth of the Peace, on Slave River, and 15 miles downstream an adult male was secured three days later.

112. **Chordeiles minor** (Forster). NIGHTHAWK.

Commonly distributed in the region, where it breeds. First noted at Government Hay Camp on June 2, 1932, and thereafter observed somewhat freely in numerous localities from Murdock Creek north to Nyarling River and west to Pine and Buffalo Lakes. A female was taken at headquarters on June 20, where it was last recorded on August 24. It was next seen here on June 6, 1933. During the summer it was regularly noted at many points south of the Peace and on the uplands west to Conibear Lake and north to the Lower Little Buffalo River. On July 14 an adult was met with on a Banksian pine ridge west of Pine Lake, with one flightless young probably two weeks old. The species was last seen on August 10.

113. **Archilochus colubris** (Linnaeus). RUBY-THROATED HUMMINGBIRD.

The writer was informed by Chipewyan residents that hummingbirds had been seen at this place in 1931, and also along Embarras River near the head of Mamawi Creek; these were doubtless *colubris*. Preble (1908, p. 390) quotes Macoun: "I have noticed the hummingbird as far north as lat. 59°, in the vicinity of Lake Athabaska." It is indisputably rare. Inquiries were made concerning hummingbirds at Fitzgerald and Fort Smith where ornamental plants bloom in abundance, but residents had evidently not seen the species at these points.

114. **Megaceryle alcyon** (Linnaeus). BELTED KINGFISHER.

From May 18 to 23, 1932, Kingfishers were frequently in evidence while descending the Athabaska and Slave Rivers from McMurray to Fitzgerald. In June and July they were often noted on streams of Alberta Plateau north and west to Great Slave and Buffalo Lakes. Last noted near Lake Athabaska on August 28. In 1933, first noted at headquarters on June 6. During the month it was rather commonly met with along many streams south of the Peace from Revillon Coupe to Birch River. From July 23 to August 2, the species was of regular occurrence on Little Buffalo River from Conibear Lake to Lobstick Creek. The last records were: Junction Lake, September 6; Pine Lake on the 8th; and Salt Creek on the 14th of the month.

115. **Colaptes auratus** (Linnaeus). YELLOW-SHAFTED FLICKER.

An abundant summer resident. Throughout both seasons it was commonly observed nearly every day in all parts of the region covered from Embarras and Birch Rivers north to Buffalo and Great Slave Lakes. Numbers appreciably diminished in mid-August, 1932, and the last bird of the season was observed on the 25th. At headquarters the earliest spring arrival was noted on May 3, 1933. This season the species prevailed with normal abundance until September 10, then dwindled in numbers, and finally disappeared on the 20th. In 1934 the first arrival appeared at headquarters on May 8, but normal abundance was not attained until the 21st.

116. **Colaptes cafer** (Gmelin). RED-SHAFTED FLICKER.

Preble (1908, p. 389) mentions that Russell reported seeing a Red-shafted Flicker at Chipewyan on May 21, 1893. This was obviously a very rare straggler, probably from the Peace River Valley. It was not personally observed, nor did any of the wardens consulted remember meeting with the species in the park.

117. **Ceophloeus pileatus** (Linnaeus). PILEATED WOODPECKER.

Occurs very sparingly throughout the region. In the summer of 1932 it was met with only on the Upper Buffalo River where five individuals were seen from July 18 to 21. Early in November two frequented heavy timber near La Butte. During the winter only five were seen in widely-separated localities. From June to November only 13 individuals were recorded in territory from Revillon Coupe and Birch River, north to Pine and Junction Lakes. Next observed 40 miles southwest of Fitzgerald on March 3, and another at Buffalo Landing, April 3, 1934. The relative scarcity of the species is demonstrated by the fact that observations work out on an average of one bird to each 300 miles of wilderness travel.

118. **Sphyrapicus varius** (Linnaeus). YELLOW-BELLIED SAPSUCKER.

Rather common and uniformly distributed throughout the country north to at least Great Slave Lake. During travels in the breeding season it was observed at comparatively frequent intervals in practically all localities visited, both in wooded lowlands of southern and eastern park districts, and over the Alberta Plateau to Upper Buffalo River. In 1932 it was last recorded on August 24. Again seen at headquarters May 3, 1933, and last observed on September 18. Next recorded on May 8, 1934. At Spruce Point, Lake Claire, a nesting tree with young was found on June 22, 1933, and another at Birch River three days later. Eight specimens were taken, all of which are typical *varius*.

119. **Dryobates villosus** (Linnaeus). HAIRY WOODPECKER.

A permanent resident of rather meagre occurrence. It is distinctly more numerous in summer than winter, indicating that the species, in this latitude, is partially migratory. In 1932 it was observed very sparingly, or not at all, in most parts visited, and with more frequency in the heavier timber of alluvial lowlands than on Alberta Plateau. Greater relative abundance obtained along Slave River during the latter half of August, followed by dwindling numbers, until with the onset of winter it became exceedingly scarce. A slight increase in numbers was evident for the early half of May 1933, but it was nowhere common during the summer. The species was not seen from October 20 to February 6; eleven were noted in March; nine in April; and none in May, 1934. Three specimens were taken; wing measurements of the two females average 5.22 inches, the male being 5.35; they are well-marked examples of the race *septentrionalis*.

120. **Dryobates pubescens** (Linnaeus). DOWNY WOODPECKER.

Remarks under the preceding species apply substantially to this Woodpecker also, though *pubescens* is somewhat scarcer. The same small numbers prevailed from May to August, 1932, with a perceptible increase, as with the "hairy", in the latter half of August—then increased scarcity. Not observed from December 8 to May 7, 1933, then, strangely enough, not another was seen until October 6, 18, and 19; this was followed again by a complete blank until February 5, 1934, when a female was collected at headquarters. Only two or three were encountered after this date. In examining the one specimen taken, Mr. Taverner advises that he sees no reason to separate it from *pubescens*, though it is from territory ascribed to *nelsoni*.

121. **Picoides arcticus** (Swainson). ARCTIC THREE-TOED WOODPECKER.

Occurs in inconsiderable numbers at any season, but it is unquestionably commoner at times in early winter than in summer. Like the two preceding species, this woodpecker in relative abundance and local distribution is variable and erratic. In the summer of 1932 it was only once detected—a solitary bird at Little Buffalo River, July 29. A female was next observed and taken at Hay Camp, September 2. Only 18 were seen during the winter and 7 in the summer of 1933. Not a single example was met with in the winter of 1933-34. The last individual was seen on May 21, 1934. Occurrence of this species, by a peculiar coincidence, was precisely the same as for the Pileated Woodpecker, namely: 27 recorded individuals in the two years, averaging one to each 300 miles of travel.

122. **Picoides tridactylus** (Linnaeus).
AMERICAN THREE-TOED WOODPECKER.

A permanent resident, but exhibits seasonal fluctuation in numbers with status similar to *arcticus*, but slightly more common. As the remarks under that species so nearly apply to *tridactylus*, intimate detail will be foregone. It may be said, however, that in the winter of 1932-33 it was most frequently noted in December, February and March. During both summers it was very rare; none was seen from May to August, 1933; sparingly noted with some regularity from September to November, but not again recorded up to time of departure from the park on May 22, 1934. On the basis of individual entries, this species occurred with a 20 per cent greater frequency than *articus*.

A series of six specimens of both sexes was secured in August, 1932, and March and April, 1933. Of these Mr. Taverner in a letter writes: "These birds certainly have more white on the back than in eastern specimens. They agree closely with a series from Mt. Logan, Chitina Glacier, and on the evidence of specimens they should be referred to the subspecies *fasciatus* (Type locality, Fort Simpson)."

123. **Tyrannus tyrannus** (Linnaeus). EASTERN KINGBIRD.

While relatively common in some restricted localities, it is absent, or very scarce in most parts; on the whole it is far from abundant. In 1932 it was relatively common in June at Murdock Creek. A pair was next observed along Lower Buffalo River on July 22. In all, 14 individuals were noted along Nyarling and Little Buffalo Rivers from July 29 to 31; the last was recorded at Salt River, August 3. First spring arrivals were noted at headquarters on June 1, 1933. In late June a few were seen in country traversed from Birch River Delta to Hilda Lake. In July the species was noted only at wide intervals from Slave River to Conibear Lake and along Little Buffalo River to the canyon. The last was seen at headquarters August 14.

124. **Sayornis phoebe** (Latham). EASTERN PHOEBE.

Common summer resident. During the 1932 season the bird was regularly noted nearly everywhere from Slave River west to Pine and Buffalo Lakes and north to Great Slave Lake. Last seen at Fort Smith, August 9. First spring arrival at headquarters May 1, 1933. Throughout the summer the species was almost daily recorded in wide areas covered both north and south of Peace River. A brood of five fledged Phoebes was seen to leave the nest at Spruce Point, Lake Claire, on June 22. A solitary individual was seen at Junction Lake, September 1, and the last at Moosehorn Slough on the 9th. In 1934, first observed at Slave River May 9th.

125. **Sayornis saya** (Bonaparte). SAY'S PHOEBE.

Preble (1908, p. 393) noted *saya* in the Athabaska Valley north to a point near McMurray, and then again only at Forts Simpson and McPherson; at the former place it appears to be of rather common and regular occurrence. Strangely enough, there seems to be a wide distributional hiatus in the Mackenzie drainage between these points where the bird has apparently never been recorded. In view of the situation, an odd straggler may be looked for in the park region.

126. **Empidonax flaviventris** (Baird and Baird). YELLOW-BELLIED FLYCATCHER.

First observed near Pine Lake, June 7, 1932. Two were seen at Junction Lake on the 8th, where a male was taken, followed by another record the next day, while a fourth was seen south of Pine Lake on the 16th. One was noted at Lobstick Creek, August 1. Not detected in 1933 and 1934. Evidently it is rather rare. Hitherto, it seems that Preble (1908, p. 395) was the first and only observer of the species in this region, where he took a male at the outlet of Athabaska Lake on June 3, 1901, and another at Fitzgerald on the 16th.

127. **Empidonax trailli** (Audubon). ALDER FLYCATCHER.

More or less abundant in most parts of the country. It was recorded with moderate regularity in the greater part of the territory traversed both summers north to Great Slave Lake; here several were heard at Pine, Presquile, and Sulphur Points. It occurred with particular frequency on the Upper Buffalo River, the full length of Little Buffalo River, and in still larger numbers in the lowlands from Revillon Coupe west to Birch River. In 1932 it was first noted on Slave River, June 3, and last recorded August 15; the next year these dates were May 29, and July 27, respectively. The birds call vigorously until late July.

128. **Empidonax minimus** (Baird and Baird). LEAST FLYCATCHER.

Over large park areas the species is abundant and notably characteristic of poplar woods wherever found; here their tireless, staccato calls fall almost endlessly upon the ear through the long summer days. The "song" period lasts from the time of arrival in May until about August 1. Depending on the presence of poplars, the species was found locally numerous everywhere north to Great Slave Lake. In 1933 it was first noted at Fort Smith, May 22, and last, at Hay Camp, August 19. It first appeared here on May 19, 1934, and became fairly common a few days later.

129. **Myiochanes richardsoni** (Swainson). WESTERN WOOD PEWEE.

Very sparingly and locally distributed. In 1932 it was noted on but three occasions: at Murdock Creek, June 23; Ile du Mort, Great Slave Lake, July 8; and Buffalo Lake, July 14. The next season it was first detected at Revillon Coupe, June 15, and its unmistakable, sweetly melancholy notes were heard on several occasions along Birch River in late June. During late July it was heard and seen with moderate frequency between Pine and Conibear Lakes and again in the valley of Little Buffalo River from Ninishith Hills to Lobstick Creek. The last entry was made at the latter place on August 1.

130. **Nuttallornis mesoleucus** (Lichtenstein). OLIVE-SIDED FLYCATCHER.

Scarce and of conspicuously local occurrence. On June 3 and 4, 1932, several were noted in wooded muskegs east of Blind Bull Lake and near Pine Lake. Late in the month two were heard calling at Murdock Creek. In July it was detected at the mouth of Buffalo River on the 9th; south of Copp Lake on the 17th; and near Mellor Rapids, Lower Buffalo River, on the 26th; this was the last record of the season. In 1933 the species was but once seen—a pair east of Brabant Lake on July 15. The birds display a distinct preference for brulé country adjacent to green timber.

131. **Otocoris alpestris** (Linnaeus). HORNED LARK.

From May 24 to 27, 1932, a flock of about 50 individuals frequented a ploughed area at Fort Smith. The birds were not again encountered until September 19 when a small restless group visited the Hay Camp meadow, to pass on the same day. Large numbers appeared here on May 11, 1933, in mixed flocks of Lapland Longspurs and Snow Buntings; the last stragglers were seen on June 2. On September 3 a sudden invasion swept into the plains at Salt Mountain (a few hours in advance of a driving snowstorm) to become exceedingly abundant in large flocks the next day. From now on groups were noted almost daily along the trail in open sandy prairies, or burned uplands, south to Cherry Mountain and Moosehorn Slough. The last straggler was observed on October 12. In 1934 a few individuals appeared at Hay Camp on May 17 and thereafter were moderately abundant in flocks of 50 to 60 members until the writer left the park on the 22nd.

A series of 21 specimens was taken in May and September, 1933. These birds are all big with white eyebrows and gray cheeks, the throats of spring birds pale, and fall ones bright. It is notable that all—even the spring specimens—have considerable ashy flecking on the upper breast just below the black crescent. Mr. Taverner, who critically examined this series at the National Museum, writes: "These must be either *arcticola* or *hoyti*. The spring series differs from a series of *hoyti* from Churchill by the breast flecking, and in being a shade paler, or ashier on the back. I am not quite satisfied with the presently accepted classification of the horned larks, but until something better is worked out I think these have to be included in *arcticola*. It is to be noted that the throat of the latter should be white, which these, and numbers of other specimens attributed to this race, are not. It is impossible to be more definite regarding these specimens without making a revision of the whole series, which would be a prodigious undertaking."

132. **Iridoprocne bicolor** (Vieillot). TREE SWALLOW.

In late May, 1932, Tree Swallows were noted daily along Athabaska and Slave Rivers to Fort Smith. During the summer they were noted sparingly in numerous places, north to Great Slave and Buffalo Lakes. It was last seen here on July 19. On May 5, 1933, a flock of eight appeared at headquarters where by the 14th the gathering had increased to 50. Throughout June and July it was seen with some regularity in the alluvial lowlands to Birch River, and in the uplands west to Conibear Lake, and along Little Buffalo River, where the last was recorded at the canyon on July 31. Next noted at Hay Camp May 14, 1934, where small flocks were common by the 19th.

133. **Riparia riparia** (Linnaeus). BANK SWALLOW.

In certain restricted localities occurs in large colonies along Peace and Slave Rivers where the birds nest in high clay banks. Away from such resorts the species is only casually met with; at no time was it seen in the upland interior of Alberta Plateau. In 1932 it was first noted near Fort Smith in early June. During July large numbers were in evidence as the Slave was descended to Great Slave Lake, being particularly notable between Le Grand Detour and McConnell Island. Last observed above Bell Rock, Slave River, August 3. In 1933 the species was seen only on June 9 and 10 along the Upper Slave, and above the mouth of Peace River on July 2.

134. **Hirundo erythrogaster** Boddaert. BARN SWALLOW.

This species is far from common and of only casual and local occurrence, though its range extends to the lower Mackenzie. On June 22, 1932, a number was seen at a low, limsetone cliff at the mouth of Murdock Creek, and again about a rocky precipice at Stony Islands, Slave River, on the 27th. Others were noted at Fitzgerald on June 4, 1933. Preble (1908, p. 454) collected a nest with five eggs in the northern arm of Great Slave Lake, on July 15, where it was built on the face of a sheer cliff; Franklin noted the arrival of the species at Fort Chipewyan on May 20, 1827.

135. **Petrochelidon albifrons** (Rafinesque). CLIFF SWALLOW.

A common summer resident where suitable rocky scarps exist for nesting. A large flock was noted at a cliff in the mouth of Murdock Creek, June 22, 1932. A few days later breeding colonies were located near headquarters and at Fitzgerald, when the nests were completed. From July 4 to 7, flocks were seen on Slave River between Fort Smith and McConnell Island. On May 23, 1933, a small flock frequented a limestone cliff at Stony Islands, where the birds had become abundant by June 4. Large numbers nest regularly on the lofty, gypsum cliffs west of Peace Point, Peace River. A few individuals and nests were observed in the Little Buffalo River Canyon on July 31. In 1934, a solitary example arrived at Hay Camp, May 21. The species appears to leave the region about mid-August.

136. **Perisoreus canadensis** (Linnaeus). CANADA JAY.

This sociable and fearless bird is one of the most familiar of permanent residents in the northern forests. In brief it may be said that the species has an almost universal distribution in the country, governed substantially by the presence of thick spruce forest; but it also inhabits mixed woods of conifers and poplars and areas of Banksian pine. There appears to be little or no difference in relative abundance as between winter and summer, pointing to general stability of population. However, it is not improbable that in very severe winters a limited north and south movement obtains.

Unquestionable active mating of Canada Jays prevails by mid-March. Testes of male specimens taken on March 3 ranged from 5 mm. in length to others that were much enlarged; largest female ovaries were consistently about 1 mm. Male organs attained maximum around the 18th, while such females as were collected registered small, or only moderate development. Early April females would doubtless exhibit very active reproductive tendencies; no specimens were secured at this time. Inferentially the first eggs are laid in this region about April 10. On May 5, 1933, a noisy family group was encountered in spruce-poplar woods where three adults were waiting upon five juveniles about two-thirds grown and but lately from the nest; all were taken, the fully-matured adults proving to be one female and two males.

In 1934 the first dark, slatey juveniles were met with on May 12—a group of four, accompanied by two adults. The former were practically full-grown; two collected had lengths of 11.2 and 11.4 inches, respectively. Two dark juveniles secured at Pine Lake, June 6, 1932, were 10.2 and 11.3 inches, indicating that maximum length is achieved early in May. The juvenile plumage is moulted some time in late June or early

July. At Rocky Point, Peace River, Warden Dent saw the first fledged young on May 2, 1934. During investigations, 39 specimens were taken in all years, and for most months, though the great majority were secured at headquarters in March and May. All are referable to typical *canadensis*.

137. **Pica pica** (Linnaeus). AMERICAN MAGPIE.

The American Magpie is a new arrival in the southern extremity of Wood Buffalo Park. The first intimation that it had reached this district was contained in a letter received from Warden Dent, dated February 10, 1936. In this he stated that "several have been caught in traps by Indians at Frog Creek"—a locality south of Hilda Lake. A specimen was secured by him and forwarded to the National Museum of Canada, Ottawa, in March of the same year. The bird was caught by Jean Toureangeau in Township 109, Range 11, near Lake Claire. This is apparently the northernmost record for the species in Alberta. Warden Dent again reported Magpies in this area during 1937.

138. **Corvus corax** (Linnaeus). NORTHERN RAVEN.

Distributed in moderate abundance throughout the whole of the region under review where it permanently resides. On April 3, 1933, a pair was noted with a bulky nest of sticks in a tall dead poplar a few miles east of Ninishith Hills, which contained three fresh eggs. During the latter half of March the birds were often seen in groups of four to six sailing leisurely high above the forest. At other times the species was noted singly or in pairs. An adult female with diminutive ovaries was taken west of headquarters on May 4, 1934.

139. **Corvus brachyrhynchos** Brehm. AMERICAN CROW.

In 1932 it was observed sparingly in practically all parts traversed north to Great Slave and Buffalo Lakes. In aggregate, more were in evidence along Slave and Little Buffalo Rivers than on Alberta Plateau. The largest numbers are found in the Peace-Athabaska Delta. The last individual was noted at headquarters September 4, 1932, and next at this point, April 8, 1933. A large flock was noted only once, when one of over 100 individuals was met with on the plain west of Salt River Settlement on August 2. Last noted August 24. The earliest arrival at Hay Camp, the following spring, was April 12; the birds became relatively common in late April.

In both of two female specimens taken at Hay Camp, May 2, 1934, the wings are 12 inches in length, which is larger than given by Ridgway for even male Eastern Crows. The size would indicate that birds of the region are referable to the race *brachyrhynchos* as listed by Preble (1908, p. 406). In relation to the above Mr. Taverner writes: "If the Western Crow (*hespris*) is a distinguishable race in Canada, I conclude that the birds of the northern woodlands are Eastern, while those of the southern prairies are Western Crows."

140. **Penthestes atricapillus** (Linnaeus). BLACK-CAPPED CHICKADEE.

Prevalent throughout the year and in all localities, though peculiar fluctuations in relative abundance seemingly exist from place to place and at different times. In 1932 it was rather evenly distributed during June and July, then became comparatively common in small companies throughout August, but was very scarce in September and October. Through the winter months it was only sparingly observed. In March and early April, 1933, a perceptible increase occurred, but the birds were seldom seen all summer. Late August saw a distinct increase, as the year before, which extended well into September. Numbers now subsided to the level noted in the winter of 1932-33. This increased from late February to early April, again to be depressed in late April and in May. One would gather from this that a differential movement prevails southward in the fall, with a corresponding late winter influx, and an exodus northward in April. Several specimens were collected.

141. **Penthestes hudsonicus** (Forster). HUDSONIAN CHICKADEE.

Only casually noted in May and June, 1932, but it was common during July in the Buffalo Lake region. Apparently no marked increase occurred in August and September as with the preceding species. Throughout the winter it was noted only at wide intervals as to time and distance, but became temporarily more numerous in late March. The birds were commoner on Alberta Plateau. At Hay Camp the species was locally scarce in April, 1934. Unlike the spring before, they were more in evidence during early May. Eight examples taken from March to May 1933 and 1934 are typical *hudsonicus*.

142. **Sitta canadensis** Linnaeus. RED-BREASTED NUTHATCH.

At best to be regarded as only casual, with an erratic summer distribution, and a spring and fall numerical increase; the species is completely absent in winter. It is therefore distinctly migratory. From June to early August, 1932, it was only four times noted; a pronounced, though modest movement occurred from August 15 to 22, followed by three casuals up to October 6. Next detected at Hay Camp, May 26, 1933, when a specimen was taken; more frequent in early June, but seldom detected in July and August. Between September 7 and 14, it was observed sparingly each day in the uplands from Pine Lake to Moosehorn Slough; the last noted and collected was at Cherry Mountain on the latter date. One was recorded at headquarters, May 4, 1934. The park is obviously near the northern limit of its range.

143. **Cinclus mexicanus** (Linnaeus). DIPPER.

While ascending Buffalo River, a few miles south of Great Slave Lake, one of these birds was observed on July 8, 1932. This appears to be the only record for the region; unfortunately the individual was not secured. The occurrence is an unusual one, far from habitual haunts. The bird possibly descended Hay River, where at its scource and in the fan of tributaries to the Upper Nelson the species may eventually be found of regular occurrence.

144. **Troglodytes aedon** Vieillot. HOUSE WREN.

Very rare. Only once recorded, when a pair was seen and the male heard singing at Murdock Creek, June 24, 1932. Apparently not previously recorded this far north along Slave River. The species is much more plentiful somewhat farther south and southwest along Athabaska and Peace Rivers. One was observed by Preble (1908, p. 483) at Fort Simpson on May 20, 1904.

145. **Nannus hiemalis** (Vieillot) WINTER WREN.

Though rare, this species was detected in three park localities. One was heard singing in dense forest on the south shore of Pine Lake, June 4, 1932. Under similar circumstances, three different birds were heard on July 20 within a mile stretch of Upper Buffalo River at the forks; the songs were unmistakable. A wren thought to be this species was fleetingly observed in dense woods at Revillon Coupe on June 14, 1933. Evidently the species had not previously been seen in this district. Preble's (1908, p. 484) record below Grand Rapid, Athabaska River, August 20, 1901, seems to be the nearest to the south. Macoun (1909, p. 703) says under *pacificus:* "Common in thick spruce woods from Lesser Slave Lake to Peace River Landing . . . in June, 1903". Preble (ibid) refers one which he collected near Athabaska Landing, September 14, 1903, to the type form ***hiemalis.***

146. **Telmatodytes palustris** (Wilson). LONG-BILLED MARSH WREN.

First observed on June 14, 1933, when two singing males were collected in a marshy lake immediately south of Revillon Coupe. With further investigations the next day, the species was found common in certain sections of the sedge and cattail border where another male was secured.

The species was next encountered at Birch River Delta, June 24, where the birds were common; many new nests were in evidence but none held eggs. The species was not seen elsewhere in the park. It is possible that in this sector it does not go north of Peace River. The northernmost previous record seems to be for the type locality of *T. p. laingi* (established by Harper, Boston Soc. Nat. Hist., V, 221, Dec. 10, 1926), main branch of Athabaska Delta, nine miles from the mouth. The park specimens are strongly ochraceous above and blend perfectly with those in the National Museum of Canada from Lac la Nonne; Edmonton; southern Saskatchewan; and Shoal Lake, Manitoba; they are quite distinct from eastern specimens, including those from Oak Lake, Manitoba.

147. **Turdus migratorius** Linnaeus. AMERICAN ROBIN.

A fairly common summer resident. It was observed in practically all localities visited north to Great Slave and Buffalo Lakes. In 1932 it was last noted in the park on October 2, but a pair was met with at Chipewyan on the 15th. Again seen at headquarters on May 1, 1933—first sparingly, then in strong migrational flocks on the 5th; they continued quite common for several days before levelling off to ordinary summer status. Seasonal flocking began about July 22. The birds were especially common in the central uplands between Cherry Mountain and Moosehorn Slough, September 8 to 13; 52 comprised the largest flock observed. Last seen on October 12, and first noted again at Hay Camp, May 3, 1934; maximum numbers were present during the second week of the month. Five specimens taken here in early May are referable to the type form *migratorius.*

148. **Hylocichla guttata** (Pallas). HERMIT THRUSH.

This delightful singer is well distributed in the region. However, it is much more numerous in the uplands of Alberta Plateau during the breeding season than in lower territory. In 1932 it was often seen from Pine Lake north to Great Slave Lake and Buffalo River. Sparingly noted in the fall and last recroded on October 5. The first "hermit" was heard singing at headquarters May 7, 1933, and by the 20th the species had become very common. On July 21 a pair was encountered on the Conibear Lake portage trail with a nest containing four young just hatched. It was last heard singing on July 23. During early September the species was still common on the western uplands, where it was last observed on the 22nd. In 1934 first noted at Slave River on May 8, where it was abundant for 10 days as the principal migrational wave went north. Several specimens were collected.

149. **Hylocichla ustulata** (Nuttall). OLIVE-BACKED THRUSH.

An abundant breeder, whose exquisite melodies so characterize the long twilight hours of northern solitudes. Over large areas it coexists with the Hermit Thrush but it is more abundant than *guttata*. The "olive-back" is common alike over Alberta Plateau and the wooded lowlands to the east and south. The last was positively identified on September 6. In 1933 the first example was detected at headquarters on May 29—then in song. A close check reveals that it arrives here about three weeks later than the Hermit Thrush. Four examples were collected between the latter date and June 22. Last heard singing July 17. The species was not seen after September 13, 1933.

150. **Hylocichla minima** (Lafresnaye). GRAY-CHEEKED THRUSH.

Though known to be a migrant through this area, it was never at any time personally detected. It is undoubtedly scarce. Preble (1908, p. 491) seems to be the only one to have seen it in this district where he took specimens at Chipewyan, May 22 and 23, 1901.

151. **Sialia currucoides** (Bechstein). MOUNTAIN BLUEBIRD.

May be regarded as a very rare possibility on the grounds of the following from Preble (1908, 499): "The Arctic Bluebird was first described by Swainson, from a specimen taken at Great Bear Lake and reported upon by Richardson. . . . King took a specimen, which was recorded by Richardson, on Great Slave Lake. The exact locality was not specified, but was probably Fort Resolution."

152. **Regulus satrapa** Lichtenstein. GOLDEN-CROWNED KINGLET.

Quite rare. In the field notes is a queried entry for a small company seen and heard high up in a spruce at Blind Bull Lake June 4, 1932. A little band was positively identified at headquarters on May 5, 1934; aside from observation, the thin, lisping calls are unmistakable. One collected was too badly multilated for preservation. Apparently the only other record for the vicinity is by Preble (1908, p. 489), when on May 27, 1901, he took a male near Point La Brie, 12 miles northeast of Chipewyan.

153. **Corthylio calendula** (Linnaeus). RUBY-CROWNED KINGLET.

A relatively common breeder throughout the region; more numerous in spring and fall; absent in winter. In 1932 it was last noted on September 8, following a pronounced influx in late August. Next noted, and two examples taken, at headquarters on May 2, 1933. It arrived in full song when snow still lingered and few other migrants had yet appeared. Males seldom sing after June 20, but a subdued song revival is often heard during the flocking and migration of early September. At this time they were seen travelling in abundance through the pine-spruce uplands about Pine Lake; last noted here on September 13. First arrival at Hay Camp May 4, 1934, where it was common four days later.

154. **Anthus spinoletta** (Linnaeus). AMERICAN PIPIT.

A migrant of moderate abundance. In the fall of 1932 flocks suddenly appeared at the Hay Camp meadows on September 6; they were common until the 16th, then as abruptly disappeared. During the following spring migration only a few small companies were seen from May 13 to 17. Fall arrival was characterized by an advance guard of a few individuals from August 23 to 29, succeeded by a strong wave over the Salt Plain and sandy ridges and prairies of the uplands from September 2 to 14; this was followed by a gradual withdrawal for five days, with only a few, rare stragglers thereafter until the 30th. First spring invasion May 9, 1934; relatively common for about three weeks, when examples were taken.

155. **Bombycilla garrula** (Linnaeus). BOHEMIAN WAXWING.

Not uncommon, but characterized by capricious distribution. During June and July numerous small, restless groups were noted on Alberta Plateau west to Buffalo River, where the last was noted July 26. A small flock arrived at headquarters May 10, 1933, from which a female was taken; the ovaries were considerably enlarged. During late June the species was seen on many occasions from Revillon Coupe to Birch River. It was last observed on August 25. Next seen May 9, 1934, when a mated pair was taken. Anderson (1909, pp. 10-12) was the first to find the "bohemian" breeding in this region. Near Fort Smith, June 10, 1908, he found a nest in a slender Banksian pine, 45 feet from the ground, containing six fresh eggs; the nest was artfully concealed in the top of a tree and draped with mosses in such a way as practically to defy detection except at very close quarters.

156. **Bombycilla cedrorum** Vieillot. CEDAR WAXWING.

Cedrorum was not unquestionably observed. All waxwings seen at close range, or collected, proved to be those of the preceding species. Some flocks noted in late June, 1933, too distant for positive differentiation in the Peace-Athabaska Delta country may have been Cedar Waxwings. Preble (1908, p. 458) remarks that the present species occurs regularly in the Athabasca and Peace River Valleys, and sparingly as far north as the upper Mackenzie. In June, 1928, Jung (1930, p. 540 noted the species along the Birch and Quatre Fourches Rivers, but does not list *garrula*. The above is apparently the first record of the Cedar Waxwing in Wood Buffalo Park, or vicinity.

157. **Lanius borealis** Vieillot. NORTHERN SHRIKE.

Very rarely observed by naturalists in this region. Only two personal records: A solitary male taken at Hay Camp on October 3, 1932 (an adult in fresh, clean, and unusually light-coloured plumage), and a pair noted at Little Buffalo River below the canyon on August 1, 1933. On June 12, 1901, Preble (1908, p. 459) saw a single bird 25 miles below the mouth of Peace River. Seton (1911, p. 399) noted it at Point Ennuyeux, Slave River, September 30, and Fitzgerald, October 5, 1907

158. **Vireo solitarius** (Wilson). BLUE-HEADED VIREO.

Rather generally, though not abundantly distributed. Both in migration, and the breeding season, it was noted in a wide variety of life-association areas. In 1932 it was only sparingly detected in the uplands to Pine Lake and at the Upper Buffalo River. In 1933 it was first noted at Fort Smith, May 21—then in full song. A male and female were taken on May 26. The species was many times encountered in late June from Chenal des Quatre to Birch River and later, a few on Alberta Plateau. A male was secured at headquarters on the 19th. One was seen at Junction Lake, September 5; two at Salt Creek on the 14th; and one was collected on the 18th—the last record of the season. Next noted at Hay Canp. May 19, 1934.

159. **Vireo olivaceus** (Linnaeus). RED-EYED VIREO.

The common vireo and one of the most abundant of the *Passeriformes*. A bird essentially of poplar woods, but casually noted in tracts of pine and spruce. Its persistent song is heard from date of arrival continuously until early August, then with irregular outbursts to the month's end. The species was noted in all parts of the region traversed during the summer. In 1932 it was last detected on September 5. Next seen at Fort Smith, May 23, and last near Moosehorn Slough, September 10, 1933.

160. **Vireo philadelphicus** (Cassin). PHILADELPHIA VIREO.

This species is one of the rarest of the region's inhabitants. It is a bird that might easily be overlooked; its scarcity is well vouched for by meagre records, or complete oversight on the part of various keen observers. The writer saw but one in 1932—a solitary male at Lobstick Creek, on August 1. On August 24, 1933, a single male was seen and collected at headquarters and two more were noted here on the 27th. Another in migration with Palm Warblers (and singing softly) was observed at

Moosehorn Slough on September 12. These are apparently the northernmost records extant. Preble (1908, p. 461-462) shot a male at Chipewyan May 23, 1901; another was taken by Russell (ibid) in the same place, June 6, 1893.

161. **Vireo gilvus** (Vieillot). WARBLING VIREO.

Occurs in moderate abundance. Its warblings were characteristic of deciduous woodlands nearly everywhere in the region traversed to Great Slave Lake. First noted at Fort Smith May 27, 1932; last at Lobstick Creek, August 1. It is evidently a somewhat later migrant than Red-eyed and Blue-headed Vireos. In 1933 it was first noted at headquarters on May 29, and finally at Ninishith Hills, July 24. The song season normally extends from time of arrival until early July, but a few singers are heard somewhat later.

162. **Mniotilta varia** (Linnaeus). BLACK AND WHITE WARBLER.

A regular breeder of moderate abundance which was noted throughout the region. It was first seen at Fort Smith on May 25; and last (a singing male) at headquarters, August 18. In 1933 it was first detected at Fort Smith, May 20; thereafter it was observed almost daily over vast reaches of the park. At headquarters a male and female were taken May 26, and a male on August 24, 1933, which was the last entry for the season. A solitary singing male appeared on May 12, 1934, but not another was noted until the 20th, when the normal migration commenced. The thin, wiry song of this species may be heard throughout the entire season of occupation, but most of the singers fall quiet in late July.

163. **Vermivora peregrina** (Wilson). TENNESSEE WARBLER.

Most abundant of the warblers and matchless for its vocal volubility and endurance. It was met with everywhere during the sunmer. In late May, 1932, it was seen and heard all along Athabaska and Slave Rivers to Fort Smith, thereafter to be seen almost daily until August 15. First observed at headquarters May 19, 1933, where in six days it was abundant; last positive entry August 22. First arrival May 18, 1934, and very abundant by the 21st. Incessant singing lasts until about July 15. Specimens taken June 10 and August 15, 1932, and May 22, 1933. In 1901, nests were found by Preble (1908, p. 466) at Fort Smith on June 20 and 27, containing five fresh eggs in both instances.

164. **Vermivora celata** (Say). ORANGE-CROWNED WARBLER.

Except in migration, this warbler appears to be only sparingly distributed in the park. It was positively identified at only a few places in

1932 from late May until late August—chiefly at Fort Smith and in the uplands about Pine Lake. At the former place the earliest arrivals were noted May 21, 1933, male specimens being taken on the 22nd and 23rd, while at headquarters a few were seen in early June. From September 5 to 9, the species was relatively common on the uplands from Junction Lake south to Moosehorn Slough, where two males were collected; not noted thereafter. The males arrived in full song at headquarters May 19, 1934.

165. **Dendroica aestiva** (Gmelin). YELLOW WARBLER.

A common summer resident which during both years was observed almost daily, in season, in all parts visited north to Great Slave Lake. From the time of leaving Waterways on May 18, 1932, until arriving at Fort Smith on the 23rd, it was commonly in evidence and continued so until mid-July, after which only a few were noted up to August 7. In 1933 it was first observed at Fort Smith on May 19, to become plentiful in three days. The species was abundant in the alluvial lands south of the Peace in June, but was much less common during July in the interior uplands to the north. A specimen was taken at Hay Camp, August 24. Two warblers glimpsed at Moosehorn Slough (in a company of Myrtle Warblers) on September 11, were thought to be this species. The song season normally lasts until early, or mid-July.

166. **Dendroica magnolia** (Wilson). MAGNOLIA WARBLER.

While occurring at times in considerable numbers during migration, it seems to be very sparingly dispersed over the region during the breeding season. It was not unquestionably noted by the writer in 1932. On May 23, 1933, a few were seen at Fort Smith, and at headquarters it was fairly common to the end of the month, where an example was taken on the 26th. During June it was sparingly encountered at Lake Mamawi and Birch River. It was not unquestionably seen later in the season. The spring migration of 1934 was markedly rich along the Slave, the species suddenly appearing in flocks at headquarters on May 20, the males in full song. The tide of migration was at the full on the 21st. On the 22nd the wave had greatly subsided.

167. **Dendroica tigrina** (Gmelin). CAPE MAY WARBLER.

The obscure Cape May, with its almost inaudible voice, is a species that may easily be overlooked by the casual observer. The species is fairly common in the region, but it is conspicuously local in distribution. In 1932 it was first detected at Hay Camp on June 2, and thereafter at a few places on Alberta Plateau; late in the month it was heard singing at

Murdock Creek. At headquarters the species was first seen on May 25, 1933, where it was not uncommon from the 26th to the 29th, when two males were taken. Thereafter it was sparingly noted to Birch River, north to Conibear Lake and northeast to Little Buffalo River Falls. Several were heard still singing here on July 30. At headquarters one was seen in low shrubbery on August 18; the last entry was for Cherry Mountain, September 8. It appeared again along the Upper Slave on May 19, 1934, being conspicuously common on the 21st.

168. **Dendroica coronata** (Linnaeus). MYRTLE WARBLER.

This warbler is the first of the family to invade the spring fastnesses of the far north. It normally arrives when snow still lingers in the woods and not infrequently while night air is yet crisp with freezing temperatures. As a migrant it is abundant, but as a local breeder rather scarce. Though it is more or less uniformly distributed in the region, it was not seen in summer over the great delta lowlands south of the Peace. In 1932 a marked migration was in force at Fort Smith from September 6 to 10. First arrival was noted at headquarters on May 7, 1933, where the birds soon became common. Adult males were taken on May 10 and 11 and a juvenile male on September 18. A strong southward movement prevailed in the interior uplands from September 5 to 11; the last were seen at Slave River on the 18th. At Hay Camp it was first noted on May 8, and two males were collected on the 10th, 1934; two days later the birds were common. The males arrive singing and the song period lasts until about mid-June.

169. **Dendroica virens** (Gmelin). BLACK-THROATED GREEN WARBLER.

To be regarded as rare; it was recorded in only two localities. On June 14, 1933, one was noted at Revillon Coupe where its unmistakable harsh, droning song was heard repeatedly. The next day another was heard on the bank of the Coupe nearer to Peace River; on the 16th, four scattered individuals were actively singing along the northern end of Chenal des Quatre Fourches. Unfortunately specimens were not secured. This sector undoubtedly represents a breeding area and the above apparently the northernmost records extant. It is rather remarkable that the only place in which Preble (1908, p. 474) noted this species, 32 years earlier, was on an island near the outlet of Athabaska Lake only 12 miles southeast of the point where the Coupe observations were made. At this place he saw several, and collected a pair in dense spruce woods on June 3, 1901. Homeward bound, the writer heard a male singing on the morning of May 23, 1934, near the south end of Embarras River. Jung (1930,

p. 540) records several seen at the mouth of Birch River, Lake Claire, June 1928.

170. **Dendroica castanea** (Wilson). BAY-BREASTED WARBLER.

Very scarce, only a few being detected during spring migration. It was nowhere seen in 1932. The following year single males were noted at Hay Camp on May 25 and 26, one of which was collected. On June 1 another one was seen, while on the 2nd, two singing males were met with and one taken. In the same locality several were observed on May 21 and 22, 1934. Preble (1908, p. 472) evidently established the first record for this district when he took a male near Point La Brie, northeast of Chipewyan, May 28, 1901.

171. **Dendroica striata** (Forster). BLACK-POLL WARBLER.

The writer's experience from 1932 to 1934 shows that this warbler occurs only sparingly in summer, and that it is not always to be seen even at the height of the wood warbler migration. As it is apparently abundant in parts of its breeding grounds very much farther north, the conclusion is that the main stream of migration passes either east of Slave River, or west of the park, or possibly both. In 1932 it was detected but once when a pair was noted at Junction Lake, June 10, and the male collected. Nothing was seen of it in the spring migration of 1933, but in June several singing males were noted at Mamawi Creek (one male taken June 20) and Birch River; in mid-July others, also in song, were seen at Conibear Lake; last noted on the 22nd. On May 20, 1934, a solitary singing male was noted with a mixed company of other warblers. During early June, 1901, Preble (1908, p. 473) found the species common near the mouth of Peace River and at Fitzgerald.

172. **Dendroica palmarum** (Gmelin). PALM WARBLER.

The status of this species in the park was found somewhat similar to that of the preceding, except that one conspicuous migration was observed. It was not recorded in 1932, and in 1933 not until late July, when solitary examples were noted at Conibear Lake and Little Buffalo River Canyon. On August 24 and 27, several were seen at headquarters and a male taken. In the uplands north of Junction Lake, September 2 witnessed a distinct southerly movement when small active bands kept passing in a tract of young Banksian pines. The next day migration was intensified, to be pronounced for over a week. A few scattered individuals were recorded until September 18. The species has been seen by very few observers in the region. Preble (1908, p. 474) noted one or two at Chipewyan, May 23, took a pair 125 miles north of Fort Smith, July 2, 1901, and found it rather common at Fort Providence in early July, 1903.

173. **Seiurus aurocapillus** (Linnaeus). OVEN-BIRD.

Fairly common in suitably forested lowlands. In 1932 it was first noted at Fort Smith on May 26, singing upon arrival. Along the Upper Slave it was well distributed, but was very sparingly in evidence west to Pine and Junction Lakes in June. Early in July it was heard on several occasions along Lower Slave River (Brulé Point and McConnell Island) and at Great Slave Lake. In 1933 the species was first noted at Fort Smith and a male taken, May 23. Thereafter it was recorded with fair regularity in May and June along the Upper Slave, and from Revillon Coupe to Birch River. In mid-July it was seen only at wide intervals from headquarters west to Conibear Lake. It is clear that the species is much more numerous in wooded, alluvial lowlands than on Alberta Plateau, where, over large areas, it appears to be absent.

174. **Seiurus noveboracensis** (Gmelin). NORTHERN WATER-THRUSH.

Well distributed throughout the region. During the term of investigations it was recorded, in season, for all localities entered from the Peace-Athabaska Delta and Birch River, north to Great Slave and Buffalo Lakes. In places it is abundant. Fresh spring arrivals for headquarters, Slave River, are, respectively, May 24, 1933, and May 19, 1934. The latest fall entry is for Junction Lake, September 6, 1933.

175. **Oporornis philadelphia** (Wilson). MOURNING WARBLER.

Only one personal record: A male in song was collected at the south end of Mamawi Creek, near the Embarras, on June 20, 1933, where it was apparently breeding. This is evidently the extreme limit of its range. The only other record within reasonable distance of the park, so far as known, is that of an immature male taken by Preble (1908, p. 477) near McMurray on August 12, 1904.

176. **Geothlypis trichas** (Linnaeus). WESTERN YELLOW-THROAT.

The southern half of the park is evidently at the northern limit of its breeding range. In 1932 the species was noted only in June at Blind Bull Lake and Salt and Murdock Creeks; at the latter place it was fairly numerous. The following year it was first heard singing at Revillon Coupe on June 13; thereafter it was noted daily west to Spruce Point and Point de Roche, Lake Claire, and up Birch River to Alice Creek. In late July it was three times encountered at Conibear Lake and along Little Buffalo River to Sucker Creek. It was not again detected. The northernmost previous record seems to be one observed by Merritt Cary, near the mouth of Athabaska River on June 1, 1903 (Preble, 1908, p. 478).

177. **Wilsonia pusilla** (Wilson). WILSON'S WARBLER.

A rare migrant which possibly breeds. The writer observed the species only near Fort Smith where a singing male was taken on May 21, 1933; two more were observed here the following day. Mr. Taverner refers the above specimen to *pusilla*. In this district it has been rarely detected. Jung (1930, p. 540) found two nests of the species, with eggs, near the mouth of Birch River on June 15, 1928.

178. **Wilsonia canadensis** (Linnaeus). CANADA WARBLER.

Rather rare and local and not observed north of Peace River. The writer first saw it at Lake Mamawi on June 11, 1933. Other solitary, singing males were noted at Chenal des Quatre Fourches on June 16, and at Birch River Delta on the 24th. It seems that the species had not hitherto been detected so far north. Preble's account (1908, p. 479) brought the northward limit only as far as McMurray.

179. **Setophaga ruticilla** (Linnaeus). AMERICAN REDSTART.

On the whole, a rather common inhabitant of the entire territory under review, though conspicuously less numerous in some parts than others. While abundant in the alluvial lowlands south of the Peace, it was only moderately common in the central uplands of the park and was evidently absent from the northwestern sector. In July, 1932, it was noted with fair regularity along the Slave to Nagel Channel, near Great Slave Lake. It appeared at headquarters in full song on May 26, 1933, when a male was taken, with another on the 29th. Both are immatures resembling the female, but with a few flecks of adult male black on the breast. No fully adult males were seen during this migration. The birds sing until at least late July. Adult-plumaged males were taken at Hay Camp on August 22, and 24, which were the last recorded.

180. **Passer domesticus** (Linnaeus). ENGLISH SPARROW.

Observed north only to Fitzgerald and Fort Smith, where in the summer it was fairly common. On June 10, 1932, a pair was seen deep within the forested interior at Junction Lake. Two females which appeared at Hay Camp May 25, 1933, were joined by a few others in late June and early July and then disappeared. One was noted by Williams (1922, p. 64) 30 miles below Fort Simpson, Mackenzie River, June 26-27, 1921.

181. **Sturnella neglecta** Audubon. WESTERN MEADOWLARK.

Though never recorded here, it is a rare possibility, first, because of essentially ideal conditions on the great grass plains between Slave River and Alberta Plateau, and second, as reflected by Preble's (1908, p. 410) remarkable record of a male taken by him at Fort Simpson on May 20, 1904. One was observed by Williams (1922, p. 64) 30 miles below this point on June 17, 1921.

182. **Xanthocephalus xanthocephalus** (Bonaparte).
YELLOW-HEADED BLACKBIRD.

Evidently confined in Wood Buffalo Park to the delta lands west of Lake Athabaska. A small colony was found in a marshy lake south of Revillon Coupe, where two males were secured on June 15, 1933. On the 24th another group was located at the north end of "Portage Lake", Birch River Delta. Four days later a few were seen flying along the southeast shore of Lake Claire, while on the 29th the largest colony was met with in a marsh to the east, immediately north of Welstead Lake. Here numerous deserted nests were noted, together with several dozen juveniles of the year just learning to fly. Preble (1908, p. 408) gives casual records for Hay River and Fort Simpson.

183. **Agelaius phoeniceus** (Linnaeus). RED-WINGED BLACKBIRD.

An abundant inhabitant of the entire region, but more so in the lowland marshes than on Alberta Plateau. While distributed practically everywhere in summer, the greatest numbers were observed in the Peace-Athabaska Delta, the Slave Delta, marshes adjacent to Buffalo Lake and along Little Buffalo River. In 1932 the species was last noted at Hay Camp on September 14, and was first observed in the spring on April 24, 1933. A flock of about 100 males appeared the following day. The first females were noted on the 12th. Juveniles were observed at Birch River Delta just leaving the nest and attempting to fly on June 29. In mid-July numerous young were still being fed by the parents at Conibear Lake, where the species was very common in the marshes at the east end. A nest with four eggs about one-third incubated was seen here on July 19. Last observed along Slave River September 9. Warden Dent reported seeing a single "redwing" at Rocky Point, Peace River, April 26, 1934.

A series of 22 adult specimens of both sexes was preserved in the spring and summer of 1933. An additional 11 specimens from Hay Camp, in late August, prove to be immatures without exception. These birds are consistently large and with heavy bills. Of the adult males all but two have wings over five inches, while of 15 comparable males from southern Ontario only two are over this figure. Bill depth measurement shows the same difference. In the above specimens only one bird from each group is intermediate, and the average difference is approximately one-tenth of an inch. The park birds are therefore plainly referable to *arctolegus*.

184. **Euphagus carolinus** (Muller). RUSTY BLACKBIRD.

Rather common locally, though rather thinly dispersed throughout the region as a whole. The aggregate of park journeys found the species in most localities from the extreme south, north to Great Slave Lake. It was least common in the delta lowlands south of Peace River, intermediate in numbers over the central uplands to the north, and most numerous on the plateau above Buffalo Lake. In particular, large flocks were located in late July, 1932, about willow-grown marshes at Copp Creek and the lower reaches of Upper Buffalo River. Casual stragglers occurred until October 17. First observed again on May 1, 1933. No flocking was observed in the fall. A pair arrived at Hay Camp, May 9, 1934, followed later by fair numbers; several specimens were taken for the collection.

185. **Quiscalus quiscula** (Linnaeus). BRONZED GRACKLE.

Rather generously dispersed and noted in varying abundance nearly everywhere to Great Slave and Buffalo Lakes. A marked preference was shown for delta lowlands, while over Alberta Plateau the species is scattered rather sparingly in pairs, or small groups about sloughs and sinkholes. Early in September pronounced flocking was in progress, but this terminated early, though a few were seen until October 2. The spring migration at headquarters was noteworthy; with a weak advance guard on April 24 in company with "redwings," it was immediately followed by others until hundreds were present on May 2. At this time the peak was reached; by the 7th not a single bird remained. During this interval a good series of specimens was procured. Again the species gathered in large numbers from September 13 to 18 and then the flocks suddenly disappeared; the last stragglers were recorded on October 3. The first spring arrivals were seen on May 5, 1934.

186. **Molothrus ater** (Boddaert). COWBIRD.

The Cowbird was only once observed in 1932, when on August 12 and 13, a few appeared at park headquarters to feed on insects among the horses. In 1933 it was first noted here May 23; thereafter three or four individuals were recorded daily until June 7. A solitary example was noted at Spruce Point, Lake Claire, June 22. It was not again observed.

187. **Piranga ludoviciana** (Wilson). WESTERN TANAGER.

In sections of the heavily wooded lowlands it is not uncommon, but it occupies Alberta Plateau to little extent. In 1932 pairs or individuals were noted with fair frequency in June and early July from Murdock Creek along the Slave to Point Ennuyeuse. To the north and west of this it was nowhere detected. At headquarters first observed June 1, 1933;

an example was secured on the 2nd. For a week thereafter singing males were frequently heard. In late June it was of daily though sparing occurrence along Birch River. A month later, a few (still in song) were observed between Pine and Conibear Lakes and along Little Buffalo River Valley to the falls. Last noted at Lobstick Creek, August 1.

188. **Hedymeles ludovicianus** (Linnaeus). ROSE-BREASTED GROSBEAK.

Of common occurrence in many sections of the country. First heard in the park June 2, 1932; it was subsequently found rather plentiful at Murdock Creek and Slave River, with slight reduction westward into the central uplands. In July it was noted on the Lower Slave to Brulé Point, at Great Slave and Buffalo Lakes and Upper Buffalo River where a few males were still singing late in the month. The species appeared at Hay Camp on May 23, 1933, soon became fairly numerous, and throughout June was found well distributed south to Rocher River and west to Birch River. With wide travel in the central uplands of the park in July, it was nowhere seen. Though the records for Buffalo River seem to be the most northwestwardly extant for the Peace-Slave sector, it was commonly heard by Williams (1933, p. 30) along Sikanni Chief, Nelson and Liard Rivers, June 5 to 25, 1922.

189. **Passerina amoena** (Say). LAZULI BUNTING.

Warden C. Cooper and his wife reported the occurrence of a pair of "Eastern Bluebirds" at park headquarters in late May, 1932. They took keen interest in the birds and were emphatic in stating that at least one of the pair possessed blue head and back, brick-red breast, and whitish underparts. As the eastern bluebird is most unlikely, the above description therefore best fits the present species, and appears to constitute a good record. The only other one for the entire region seems to be Preble's (1908, p. 449) for a male taken by his party at Fort Providence, July 4, 1903.

190. **Hesperiphona vespertina** (Cooper). EVENING GROSBEAK.

On July 26, 1932, a bright male of this species was observed at Boundary Creek, Buffalo River (latitude 60°31′). The date may be significant in connection with local breeding. This appears to be the northernmost and only record for the entire region with the exception of one given by Preble (1908, p. 413-14): "Bonaparte records two specimens 'shot early in the spring on the Athepescow Lake near the Rocky Mountains'. Later he figured and described one of these specimens, this time giving the locality as 'Athabaska Lake'." This author (ibid) observed the species at Grand Rapid, Athabaska River, while Macoun (1909, p. 447) noted it as far north as Dunvegan, Peace River, with young just able to fly on July 26, 1903.

191. **Carpodacus purpureus** (Gmelin). PURPLE FINCH.

In 1932 first noted at Fort Smith on May 26. Throughout June it was many times seen west to Pine and Junction Lakes and at Murdock Creek. It was next noted at Hay Camp, May 2, 1933, where moderate numbers occurred throughout the month. It was noted breeding here on the 26th and 28th when three males and one female was secured. A male was heard singing at Modere Creek, Birch River, June 26. At Ninishith Hills a group of four was observed on July 24. A solitary male appeared at headquarters May 8, 1933; one was taken on the 11th; again recorded on the 18th and 19th. These apparently constitute the farthest north records for the district. Previously it was taken by Preble (1908, p. 415-16) ten miles below the mouth of Peace River on June 10, 1901, and by Russell (ibid) at Chipewyan, June 5, 1893.

192. **Pinicola enucleator** (Linnaeus). PINE GROSBEAK.

Evidently of only sparing distribution in the region at any season. Preble (1908) and Seton (1911) give a very few summer records north from Great Slave Lake. At this season it was nowhere met with in Wood Buffalo Park. The first was seen at La Butte, November 7, 1932, followed by only four others throughout the winter. On May 27, 1933, a pair flew northward past headquarters. The following winter the species was only twice observed—solitary males, at Hay Camp October 10, and Buffalo Landing March 1, 1934, respectively.

193. **Leucosticte tephrocotis** (Swainson). GRAY-CROWNED ROSY FINCH.

May be regarded as a rare possibility in the park area by virtue of a single record by Preble (1908, p. 417): "In the museum of the Hudson's Bay Company at Fort Simpson I found a specimen of this species, taken some years ago at Fort Resolution."

194. **Acanthis hornemanni** (Holboell). HOARY REDPOLL.

Fairly common during the winter months. They were first seen at headquarters September 29, 1932, and many others in early October, banded with Common Redpolls, when one of the former was collected. Flocks of 50 or more members at this time regularly fed on alder and birch catkins along Slave River. Flocks with many white-rumped, "frosted" birds were common on the plains north of Peace River from this date until late November. None was seen thereafter until March 6, when mixed flocks of Common and Hoary Redpolls appeared again along Slave River in considerable numbers. A male "hoary" was taken on the 10th. Very pale birds were last seen at Salt River, west of Fort Smith, on April 6. The present species was next detected on October 17, 1933, and a female secured on the 20th. It was frequently observed during the winter, being most abundant in March. It was last recorded when a female was collected on April 27. The race represented here is *A. h. exilipes.*

195. **Acanthis linaria** (Linnaeus). COMMON REDPOLL.

This redpoll appears to be appreciably more abundant, spring and fall, than the preceding species, with which it regularly associates. In the fall the two forms arrive together and henceforth have an essentially identical status, though in mid-winter *exilipes* seems to predominate. On the whole, the foregoing account might well apply to this species also. In 1932 two specimens were taken October 3, and seven on October 20, 1933, when the birds were plentiful on both occasions and greatly outnumbered the Hoary Redpolls which were mingled with them. Unlike *exilipes*, this species occurs very sparingly in the park during summer, when in the east-central sector small flocks were noted during late August, 1933. Likewise, flocks of dark-coloured redpolls were noted in late May. The birds are most abundant in October, November, and March.

The writer has no breeding records for the park, but it may nest in the northern area. Preble's party found it common at Fort Resolution during July 1, 1901, and nesting in May at Fort Simpson. Young birds just from the nest were taken by him here on May 24, 1904.

196. **Spinus pinus** (Wilson). PINE SISKIN.

It was only once positively recorded, when a small flock was observed at Cherry Mountain on September 9, 1933. It appears, fortuitously, not to have been recorded previously from the district, but accounts by Preble (1908), Seton (1911), and Williams (1933) indicate that it is relatively common on central Athabaska River, and again on Mackenzie River below Fort Simpson. In all likelihood the main siskin migration from Central Alberta is west of Birch and Caribou Mountains and Cameron Hills, to the Mackenzie.

197. **Loxia curvirostra** Linnaeus. RED CROSSBILL.

Seton's record (1911, p. 390) seems to be the only one for the district, based on a specimen collected on September 28, 1907, a short distance from the mouth of Slave River.

198. **Loxia leucoptera** Gmelin. WHITE-WINGED CROSSBILL.

Generally considered, these birds are not uncommon, but they may be locally rare, with erratic distribution and occurrence, resulting in irregular observation. During June, 1932, flocks were noted on several occasions in the uplands north and south of Junction and Pine Lakes. In July a few were encountered at Green Island and Point Presquile, Great Slave Lake; at Buffalo Lake; and on the Upper Buffalo River. At Chipewyan a group of 42 was seen on October 15. A flock of both sexes was next met with at Point Providence, December 15, actively feeding on the cones of white spruces. A flock was seen at Sucker Creek, April 1, 1933. There are no summer entries. Next observed a few at headquarters, October 31, and larger groups in early November when a male was secured.

199. **Passerculus sandwichensis** (Gmelin). SAVANNAH SPARROW.

One of the most plentiful of sparrows. Throughout both summers it was seen in more or less abundance in all parts of the country traversed where suitable conditions prevailed. In particular, the species was met with in large numbers in the whole Peace-Athabaska Delta west to Birch River. It is also notably common in meadows and moist grassy plains along the east side of the park from Peace River north to Little Buffalo and Nyarling Rivers and in Slave River Delta. Though well dispersed in grassy depressions over Alberta Plateau, it is apparently not nearly so plentiful as in the lower plains and alluvial lands referred to. In 1932 the species was last noted in late September. The following year it appeared at headquarters on May 4 and was last seen on September 30, arriving in 1934 on May 9.

In the two seasons, 24 specimens were taken, chiefly at Hay Camp during May and August. Mr. Taverner, after critically examining this series at the National Museum, can see no difference in the specimens as compared with those from the southern part of the Prairie Provinces. He had previously proposed a new name, *P. s. campestris* (1932, pp. 201-5), type locality, Red Deer, Alberta, for birds in the Prairie Provinces of Canada, north to the Mackenzie. If *campestris* is distinct from *nevadensis* (which has been questioned), the park specimens belong to that race; otherwise Mr. Taverner would refer them to *nevadensis*.

200. **Passerherbulus caudacutus** (Latham). LECONTE'S SPARROW.

Well distributed, but often requires diligent search for its detection. It is a bird rather difficult to flush and collect and beyond doubt occurs in many places where it has been overlooked. It was found rather common in numerous places from the southern marshes to Great Slave Lake, being especially numerous in the willow-grasslands surrounding Lakes Mamawi and Claire. In spots, it was hardly less common along Nyarling and the lower length of Little Buffalo Rivers. On Alberta Plateau it is much more thinly distributed. At Lobstick Creek one was taken August 1, 1932.

The first was noted in song at headquarters May 9, 1933, and a specimen taken the next day. Others were secured August 18, and September 18, respectively, the last being noted on the 21st. Next observed May 12, 1934, when several singing males suddenly appeared over night and two were taken. In a few days it was relatively common.

201. **Ammospiza caudacuta** (Gmelin). NELSON'S SPARROW.

Owing to Preble's admirable work in the Athabaska-Mackenzie region, the writer was aware of this sparrow as a possibility in the park fauna. Extensive search was made for it, but the species was never found. For the entire region north of the Clearwater there are apparently but two records, both by Preble (1908, p. 429)—a male taken on June 12, 1901, 25 miles below the mouth of Peace River; and three birds from the marsh at the mouth of Hay River, June 30, 1903.

202. **Pooecetes gramineus** (Gmelin). VESPER SPARROW.

There is but one personal record: a singing male was observed at Fort Smith on the morning of May 18, 1933. Preble (1908, p. 427) is evidently the only other one to record the species in this district and by a strange coincidence he also saw it only at Fort Smith, together with several others (one taken) in a prairie a few miles west, June 21-24, 1901. Williams (1933, p. 30) says: "Two nesting below Norman, June 28."

203. **Junco hyemalis** (Linnaeus). SLATE-COLORED JUNCO.

A common summer resident throughout the greater part of the park, especially north of Peace River. In extensive tracts south of this stream it is very scarce or absent. In September, 1932, the birds were very numerous along Slave River; greatest concentrations obtained during the third week of the month. The last straggler was noted on October 17. It apeared at headquarters April 26, 1933, to increase rapidly and reach the peak of abundance between May 5 and 13. Birds obviously mated were first seen segregated from the flocks on the 10th. The greatest volume of migrating juncos the next autumn appeared along Slave River between September 16 and October 2; the last straggler was seen on November 4, two weeks after all others had disappeared. The vanguard of the 1934 spring migration reached Hay Camp May 4, followed almost at once by strong reinforcements which reached maximum numbers between the 10th and 15th. A series of 22 specimens was preserved, all of which are typical *hyemalis*.

204. **Spizella arborea** (Wilson). TREE SPARROW.

A migrant which breeds in the Hudsonian Zone. In 1932 it was observed rather sparingly at Fort Smith, May 23 to 26, the main migration having already passed on. In the autumn a few appeared on September 14, to become common in four days, with peak abundance on the 27th, then progressive diminution until the last disappeared on October 21. Appeared at headquarters the next season on May 3, where in small numbers it tarried until the 11th, but it was again observed sparingly at Fort Smith on May 21 and 22. A solitary migrant was met with on the Salt Plain on September 2; a few days later small groups appeared, then they became common in the uplands along the Peace Point trail between Pine Lake and Moosehorn Slough. Peak abundance was reached at Slave River during the last week of the month; the last individual was noted October 29. The spring migration of 1934 was notably meagre, only one bird having been seen on May 12 and a few others on the 14th.

After examining the five specimens taken at Hay Camp, Mr. Taverner advises that he cannot distinguish these birds from eastern *arborea*; he remarks further that the situation is strange in view of the fact that while birds from Churchill are *arborea*, those from the southern part of the Prairie Provinces seem to be *ochracea*.

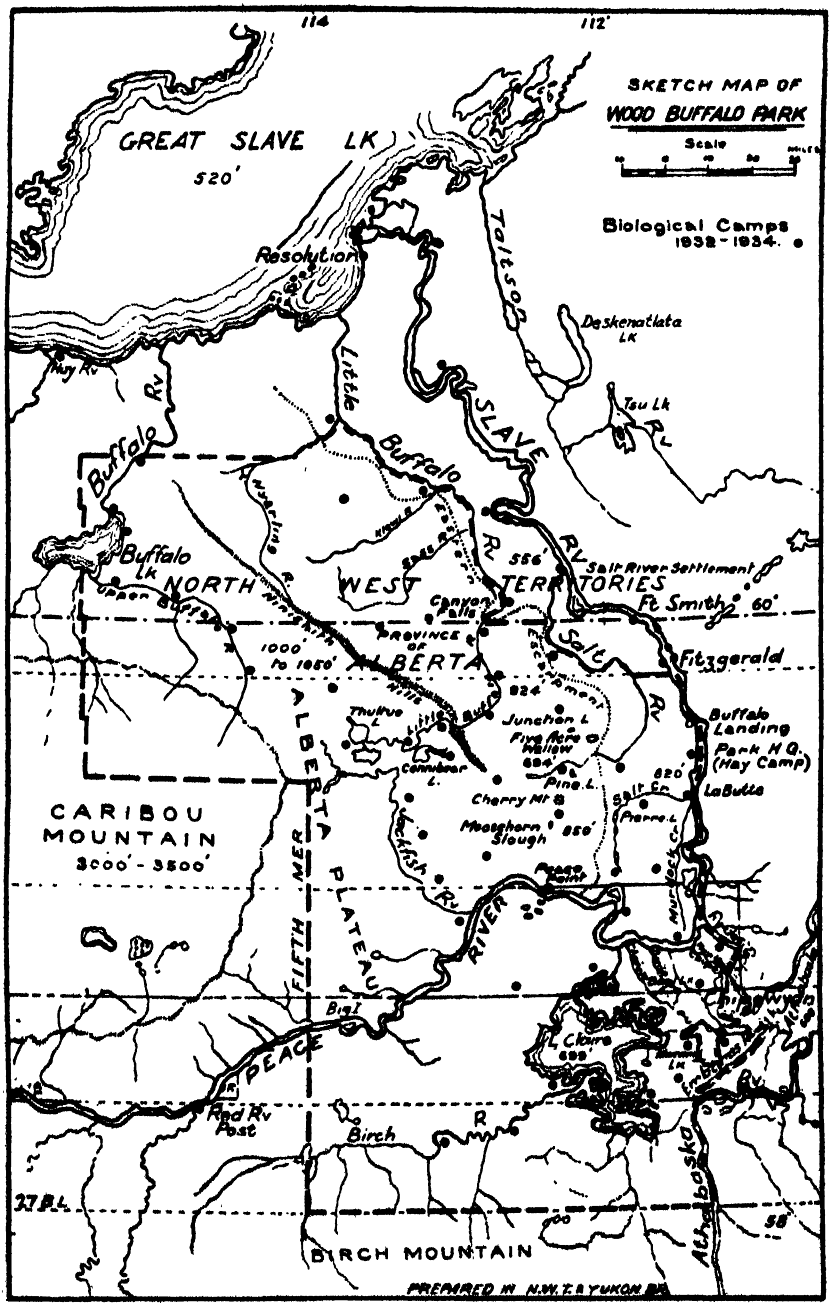
205. **Spizella passerina** (Bechstein). CHIPPING SPARROW.

Relatively common summer resident, much more numerous in migration. It was noted almost everywhere throughout the park to Buffalo Lake and Nyarling River and at Great Slave Lake. In the southern part of the area it is much commoner than in the north. For the seasons of 1933 and 1934 it was first observed on May 19, and 17, respectively, becoming plentiful in a few days. In the later season a very pronounced migration took place within 48 hours of the first scattered arrivals, when for several days the birds appeared in flocks of scores of individuals. No flocking was noted during either autumn spent in the region; in both cases the species was last recorded during the third week of August.

According to the A.O.U. Check-List, 1931, the type form is found in this region. Preble (1908, p. 437), however, refers these northwestern birds to *arizonae* Coues, as does Mr. Taverner also, upon examining the writer's specimens from Fort Smith and Junction Lake.

206. **Spizella pallida** (Swainson). CLAY-COLORED SPARROW.

In some central sections of the park this sparrow is not uncommon, but from here north to Great Slave Lake it seems to be progressively scarcer. It was first detected in a dry meadow west of Hay Camp on June 2, 1932; thereafter it was noted singing on numerous occasions west to Pine Lake and north to Junction Lake and "Five-acre Wallow". In every instance, farther west, it was seen in shrubby prairies which characterize many portions of the eastern part of Alberta Plateau. On August


SKETCH MAP OF
WOOD BUFFALO PARK
Scale
Biological Camps
1932-1934. ●
114
112°
GREAT SLAVE LK
520'
Resolution
Hay Rv
Buffalo Rv
Little Buffalo Rv
Taltson
Deskenatlata Lk
Tsu Lk
Rv
SLAVE RV
Buffalo Lk
NORTH WEST TERRITORIES
Upper Buffalo
Nyarling R.
Escarpment
556'
Salt River Settlement
Ft Smith
60°
Canyon Falls
PROVINCE OF ALBERTA
1000' to 1050'
Salt Rv
Fitzgerald
824
Junction L
Thultue L
Five Acre Wallow
684'
Buffalo Landing
Park H.Q. (Hay Camp)
Conibear L.
Pine L.
820'
Salt Cr
LaButte
Cherry Mt
Pierre L
Moosehorn Slough
850'
Jackfish Rv
Peace Point
Murdock Cr
CARIBOU MOUNTAIN
3000' - 3500'
FIFTH MER
ALBERTA PLATEAU
RIVER
Big I
PEACE
Red Rv Post
Birch R
L Claire
699'
Chipewyan
Lk
Embarras Rv
27 B.L.
Athabaska
58
BIRCH MOUNTAIN
PREPARED IN N.W.T. & YUKON BR.

1 several were seen at Lobstick Creek and a male taken, while the next day it was more common along the edge of prairie openings near Salt River. Another male was collected at Hay Camp, August 15. First observed at Fort Smith, May 23, 1933. During the latter part of June the species was noted on many occasions in the dryer grassy flats from Rocher River and the northeast shore of Mamawi Lake to Spruce Point, Lake Claire.

207. **Zonotrichia querula** (Nuttall). HARRIS'S SPARROW.

A species of the higher north found here only in migration. At Junction Lake a solitary, belated male was observed on June 8, 1932. In the autumn it appeared sparingly at headquarters from September 23 to 25. The spring migration was scanty with only a few birds in evidence from May 5 to 11, when two males were secured. It was locally common along Upper Slave River September 20 to 24, (four more birds being added to the collection) while solitary examples were noted on October 6 and 14. In 1934 large numbers suddenly appeared overnight at Hay Camp on May 19, associated with White-crowned and White-throated Sparrows; here they swarmed for several days in dry aspen woods and shrubbery about the meadow, then passed on.

208. **Zonotrichia leucophrys** (Forster). WHITE-CROWNED SPARROW.

Occurs in the park as a migrant; however, it may nest sparingly in the extreme northern portion of the area, as it is on its breeding ground along the south shore of Great Slave Lake. Here only was the species personally seen during the summer months, being fairly common in July, 1932, at Resolution, Green Island, and Point Presquile. That fall, large numbers invaded the Slave River woods from September 1 to 5, then withdrew bodily with the same abruptness with which they first appeared. The next spring only a very few were noted between May 8 and 11 and, singularly, none at all during the succeeding fall. In 1934 a generous wave reached headquarters on May 19 in company with the first contingent of Harris's Sparrows.

209. **Zonotrichia albicollis** (Gmelin). WHITE-THROATED SPARROW.

A common summer resident; noted throughout the entire area north to Great Slave Lake. The high-pitched whistle of this species is one of the most characteristic sounds of the summer northland where it is heard in June with great frequency day and night. Both years it arrived at headquarters on May 8 and was in migration again during the early half of September, though individuals were noted as late as the 22nd. A nest with five eggs, on the point of hatching, was found in a spruce woods at

Mamawi Creek June 20, 1932, and on the 26th, another at Spruce Point, Lake Claire, with four nestlings one or two days old. The latter nest was under shrubbery at the edge of the beach.

210. **Passerella iliaca** (Merriam). FOX SPARROW.

During the summer of 1932 this sparrow was nowhere detected in the upper length of the park, or vicinity, until one was taken at Lobstick Creek on August 1. The only other example was noted at Hay Camp, September 4. While doubtless somewhat commoner than the above would seem to indicate, it is nevertheless a scarce breeder. During the spring migration at headquarters only five birds in all were seen from May 4 to 6, 1933, when a female was collected. In late June a few individuals in full song were noted from Mamawi Creek to Birch River where they were undoubtedly nesting. Another singer was seen near the outlet of Athabaska Lake on July 1. Between September 7 and 14 the species was tolerably common in migration through the uplands north and south of Pine Lake. North of Cherry Mountain a male was taken on the former date. Not a single example was discovered in the spring migration of 1934. The specimens taken are typical *iliaca*.

211. **Melospiza lincolni** (Audubon). LINCOLN'S SPARROW.

A relatively common breeder, but very locally distributed; over large areas it was not detected. In June and July, 1932, the species was found rather numerous along Salt and Murdock Creeks and Little Buffalo, Nyarling, and Upper Buffalo Rivers. Its song was heard as late as August 1. Not observed in the 1933 spring migration at Slave River, but in June it was frequently met with about Revillon Coupe, the Quatre Fourches, Upper Mamawi Creek, and at Birch River. In late July several singers were heard west of Pine Lake and along Little Buffalo River to Ninishith Hills and Sucker Creek. One was taken at Hay Camp, September 21, and another on October 1. The species was not detected during the following spring.

212. **Melospiza georgiana** (Latham). SWAMP SPARROW.

Breeds freely throughout the area. It attains greatest abundance in the alluvial lowland marshes, but it is also well distributed in the higher lands of Alberta Plateau. It was found numerous in ideal surroundings at Conibear and Buffalo Lakes and along the lower portions of Lilypad and Upper Buffalo Rivers. The denser populations, however, occurred locally along Nyarling and Little Buffalo Rivers and throughout the Peace-Athabaska Delta. In some places here the birds were unusually common, their pebbly songs rising on every hand. Singing ordinarily ceases at the end of July, but one was heard as late as September 9. In the spring of 1933 the first was noted at Fort Smith on May 19. A marked influx was observed at headquarters after August 21, the peak of the movement being at the end of the month, but the species remained common until the third week of September. The last solitary bird was noted on October 6. Between August 22 and September 21 six examples were taken; all prove to be juveniles in heavy moult.

213. **Melospiza melodia** (Wilson). SONG SPARROW.

Occurs throughout the park area and north to Great Slave Lake, but north of Peace River it is rather scarce. In June 1932 it was noted only at Murdock Creek where several birds were heard singing their familiar refrains. Next observed at the forks of Upper Buffalo River July 20, and a week later, at the mouth of Buffalo River; at Fort Resolution; and along Little Buffalo River. Last noted on August 16 at Buffalo Landing. It was next seen at Hay Camp, May 9, 1933. In June it was often noted south of Peace River, westward to Birch River, where the species was locally common. It exhibits a marked preference for these lowlands about the lakes where dense stands of willow alternate with open grasslands. In July the species was seen only three times north of the Peace—all at Little Buffalo River in the general vicinity of the falls. It was only twice noted in August, and last positively recorded September 3.

214. **Calcarius lapponicus** (Linnaeus). LAPLAND LONGSPUR.

An Arctic species which occurs regularly in migration, but varies in abundance as between spring and fall and from year to year. The 1932 fall movement was distinctly moderate with small flocks in evidence from Fort Smith to Hay Camp between September 6 and 16. A flock of about 200 appeared at headquarters May 11, 1933, accompanied by Horned Larks; the birds tarried only two or three days and then disappeared. Next observed on the Salt Plain west of Fort Smith on September 4 where several flocks suddenly appeared in advance of a snow storm. Thereafter for two weeks it was frequently met with in prairie openings of Alberta Plateau south to Moosehorn Slough. Upon reaching headquarters on September 15, the birds abounded in Slave River meadows where they lingered in abundance until the 23rd, then for the most part abruptly withdrew. Stragglers remained until October 5. In the spring the species returned here in large flocks on May 20 to remain for several days. Fifteen specimens were taken in May and September, 1933, which are referable to typical *lapponicus*.

215. **Calcarius lapponicus alascensis** Ridgway. ALASKA LONGSPUR.

Records show a relatively close proximity of this race to the park district where it may occur as a migrant, but evidently, as yet, this has not been established. Preble (1908, p. 425) found *alascensis* common at Fort Simpson in the spring of 1904 where it far outnumbered *lapponicus* during the first three weeks of May. The A.O.U. Check-List, 1931, credits the present form with ranging as far east in migration as Fort Resolution. In the light of present information and the collections made at park headquarters, it would appear that *alascensis* is at least very scarce here in migration and that the main flight to and from the Mackenzie Valley follows a line west of Wood Buffalo Park.

216. **Calcarius pictus** (Swainson). SMITH'S LONGSPUR.

This longspur was observed only during the fall migration of 1932 when small flocks visited meadows at headquarters from September 6 to 17. The species arrived in maximum numbers overnight, which was maintained for about one week, after which there were only a few stragglers. This seems to be the first mention of migration in this area, though Preble (1908, p. 426) gives a record for Fort Resolution. It is consistently more numerous farther west, but it breeds in the Arctic and sub-Arctic east to Churchill, Manitoba, where Taverner and Sutton (1934, p. 80) found it locally common. Migration in the Slave River Basin appears to be limited and erratic.

217. **Plectrophenax nivalis** (Linnaeus). SNOW BUNTING.

A regular and usually an abundant migrant. In 1932 the birds first appeared in small flocks along the Slave on September 3, to become abundant on the 6th; this was sustained until the 22nd after which withdrawal was equally rapid with the last straggler noted on the 26th. The following spring migration was remarkably heavy. Examples first appeared on March 30 and the peak of abundance was reached with hundreds of individuals on April 29. A pronounced exodus occurred in the next 48 hours, but a few lingered until May 24. Chief occupation for this point en route thus lasted for 32 days, with extremes covering a period of 55 days.

The succeeding fall saw no buntings until October 8. Small detachments now arrived along the muddy margin of Peace River and, shortly after, large flocks visited headquarters to tarry in teeming abundance until early November. The interesting feature is that the species was 35 days later in reaching this district than in the previous year, with a corresponding lag in departure. In 1934 a solitary male appeared at headquarters for several days in February—the only one observed in the region during mid-winter. Another was noted on the Salt Plain March 1, not to be again recorded until April 2. Flocks arrived after this to reach maximum from April 20 to 25. A warm spell now set in for four days when not a single bird was seen. But with freezing temperatures again on the 30th, the flocks appeared once more almost as numerous as ever, particularly from May 2 to 5, which was a very stormy period. On May 8 the majority departed, while a few lingered until the 17th. A notable feature of this vernal pilgrimage along the Slave was the apparent lack of females. Of 12 specimens taken here during April and May of both years, all are males. This is in harmony with the writer's observations in the Eastern Arctic where the latter sex appears, and subsequently bursts into full song, well in advance of the earliest arriving females.

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A double sink hole in Banksian pine forest on the Alberta Plateau a few miles east of Conibear Lake, July 1933. Example of biotic community type (*a*).

Heavy spruce-aspen-pine forest in the interior of the park at Pine Lake, November 1932. Biotic type (*c*).

Aspen forest near Salt Creek (Salt Plains elevation) five miles west of Slave River, October 1932 Biotic type (*d*)

Pre-Cambrian rock outcrop along Slave River about 14 miles south of Fitzgerald, March 1933 Biotic type (*f*)

A FAUNAL INVESTIGATION OF THE SAULT STE. MARIE REGION, ONTARIO*

GENERAL INTRODUCTION

Continuing the Museum's programme of surveys of faunally unknown, or inadequately known, areas in Ontario, field work in the Sault Ste. Marie region was accomplished during the summer of 1931. The area investigated lies along the southern border of Algoma District which occupies a central position in our irregularly-shaped province. More exactly, the information presented in the following reports concerns a belt approximately ten miles wide, extending along the North Channel of Lake Huron and the drainage of Lake Superior, starting at Thessalon on the east and thence west and north to Goulais Bay on Lake Superior and including St. Joseph Island and the small Canadian Islands in the St. Joseph Channel (see map).

The Museum's field party at the outset consisted of Messrs. J. Edmonds, E. B. S. Logier, D. A. MacLulich, T. M. Shortt and the writer. We reached the region on June 1, 1931, and after a trial-and-error procedure finally established a headquarters camp in a vacant farmhouse near the St. Joseph Channel and the post-office of MacLennan. Collecting was carried on most extensively within walking distance of this camp but we reconnoitred the larger area, as outlined above, by automobile. On July 3, we were joined by Mr. J. L. Baillie and on July 7, Prof. A. F. Coventry arrived. Work was concluded by the end of July.

DESCRIPTION OF THE AREA

Since this region has received attention from geologists, foresters, etc., there is a considerable literature to which the reader can be referred but a brief descriptive sketch is given here to serve as a background for the presentation of our zoological findings. The area presents certain conspicuous physical features to the visitor who travels through it. Next to the coast of the Great Lakes water system (in detail, the borders of the North Channel of Lake Huron, Lake George, Little Lake George and also the St. Mary River) one travels a somewhat irregular and winding plain. The Great Lakes water level is here about 580 feet above the sea and the plain is not much higher (Thessalon, 656; Desbarats, 595; Sault Ste. Marie, 634). In places the plain narrows somewhat and again it broadens out into a vista of fields or woodland. Occasionally a ridge of rock is crossed, or an island-like prominence is observed to stand out above the flatland. These prominences are projections from, or outliers of, the hard-rock hills which rise up above the plain to the north. To the east, largely outside our area, this formation comes down to, and forms, the coast.

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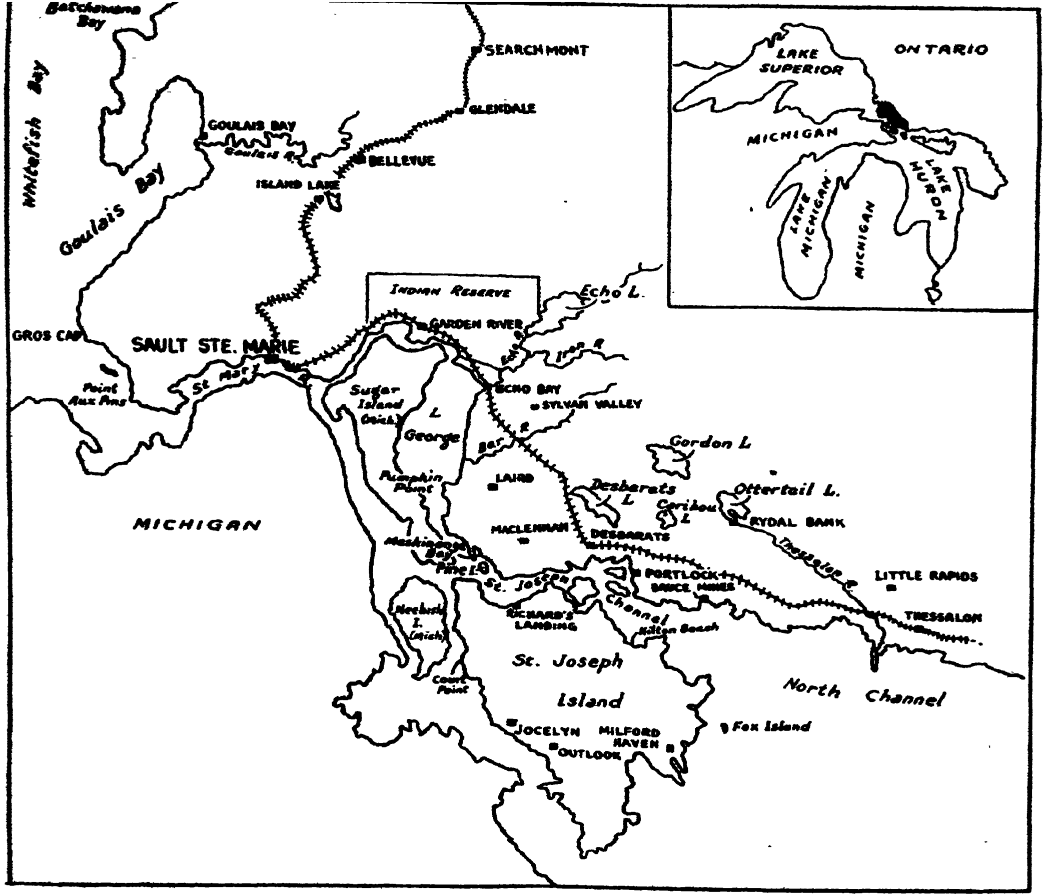
*Contribution No. 21 of the Royal Ontario Museum of Zoology.

These physical features are seen at a glance because of changes wrought by man. On the plain is a superficial deposit of soil—boulder clay, stratified lake clays and sand—some suited to agriculture; consequently much of the forest has been removed and farms established. These soils are largely glacial deposits, in part levelled by glacial Lake Algonquin and by its successor the Nipissing Great Lakes stage which left its mark in the form of terraces and beaches (Coleman, 1922). Basically the plain is underlain by Palaeozoic rocks—sandstones, shale and conglomerate (Collins, 1925) with an occasional outcropping of Bruce limestone—but the high border of the area (1,000 to 1,350 above the sea, 25 miles inland) and extending far to the north is the Precambrian Shield. If one travels inland he finds that numerous depressions in these hard rocks are filled with glacial drift, or that they serve as catchment basins for numerous rock-rimmed lakes. North of Sault Ste. Marie and extending westward, south of Goulais Bay, a bold granite ridge comes to the very shore of Lake Superior and its tip in the mariners' guide, Gros Cap.

FOREST

This region was once heavily forested. Inland on the Canadian shield white pine probably dominated and on the clay soils of the plain, spruce, balsam and hardwood. Merchantable timber has been largely removed since 1870. Second growth stands of the types mentioned now exist but the scars of axe and fire can be seen throughout the area, even against the inland horizon. The largest remaining area of old forest is to be found in the Echo River valley on the Indian Reserve.

Reference to a generalized account of Ontario's forest resources by Sharpe and Brodie (1931) should be made in connection with a consideration of the forest of the Sault Ste. Marie area. (During our field-work casual attention was given to plant life but we were primarily concerned with animal life.) These authors regard the forest of the region as an extension of the Ottawa–Huron forest situated to the east and south. They point out that though there is similarity of species of trees certain differences are apparent. Beech and basswood are absent, or nearly so, in this region, while jack pine is present, thus making a conspicuous difference between the Algoma extension and the Ottawa–Huron forest proper. But in general these forests are similar,


Batchawana Bay
Whitefish Bay
Goulais Bay
GOULAIS BAY
Goulais R.
SEARCHMONT
GLENDALE
BELLEVUE
ISLAND LAKE
GROS CAP
SAULT STE. MARIE
Point Aux Pins
St. Mary's R.
INDIAN RESERVE
GARDEN RIVER
Echo L.
Echo R.
Iron R.
ECHO BAY
SYLVAN VALLEY
Sugar Island (Mich.)
L. George
Bar R.
Pumpkin Point
LAIRD
MACLENNAN
Gordon L.
Desbarats L.
Caribou L.
Ottertail L.
RYDAL BANK
DESBARATS
Thessalon R.
LITTLE RAPIDS
PORTLOCK
BRUCE MINES
THESSALON
Mashinonge Bay
Pine L.
St. Joseph Channel
Neebish I. (Mich.)
RICHARD'S LANDING
Hilton Beach
St. Joseph Island
Coast Point
JOCELYN
MILFORD HAVEN
OUTLOOK
Fox Island
North Channel
MICHIGAN
LAKE SUPERIOR
ONTARIO
MICHIGAN
LAKE MICHIGAN
MICHIGAN
LAKE HURON

"from the valleys to ridge-tops there is the same domination of conifers in the lower levels and of the tolerant hardwoods on the ridges". In more detail, "in depressions and on the flat lands bordering streams are pure coniferous stands of spruce, mostly black. In well-drained valleys and on the lower slopes is a mixed coniferous stand, composed of white spruce and balsam, with a representation of black spruce, cedar, white pine and white birch. Farther up the slope the hardwood content increases by the occurrence of yellow birch, and a mixed hardwood–softwood stand of white and yellow birch, white spruce, balsam and the occasional white pine extends to the margin of the pure hard maple stands on the upper slopes and ridges." This quotation will suffice to characterize broadly the forest of the area, although we would like to add that hemlock occurs in certain better-drained areas and in some situations it is dominant.

The discovery of a few plants by our field party seem worthy of mention: Along the St. Joseph Channel on rock terrain, Common Juniper (*Juniperus communis* var. *depressa*) was established; at Gros Cap we identified the Salmon Berry (*Rubus parviflorus*); and in hardwood stands near Maclennan, Basswood (*Tilia americana*), Ironwood (*Ostrya virginiana*) and Beech (*Fagus grandifolia*) were recorded, the latter on a single specimen.

For further botanical details the reader is referred to a recent study (Hosie, 1938) of the vegetation of the Batchawana Bay region which lies a few miles north of the area surveyed by us. Although the Sault Ste. Marie region has been altered extensively by man, we found conditions similar to those described by Hosie in his comprehensive and important report.

We should add to our brief description of the Sault Ste. Marie region some comment on industry, settlements and transportation developments. Sault Ste. Marie, a community with a long and interesting history (since 1615), is a modern city with a population of 23,082 (in 1931). It is the site of an important canal past the rapids of the St. Mary River through which passed in 1931, 2,219,567 tons of interlake freight and 20,626 passengers on a total of 3,094 Canadian and United States vessels. The principal industries of the area are steel works and the making of pulp and paper. Agriculture is of local importance only. No other large settlements are found in this region. Of the villages and towns, Thessalon is the largest with a population of 1,632.

The Canadian Pacific Railway traverses the area from the east (Sudbury) to Sault Ste. Marie and the Algoma Central Railway terminates there from the north. Also a good motor highway roughly parallels these railways within the area and many roads and trails serve the farmland and even penetrate parts of the rugged rock country to the north.

CLIMATE

Some indication of the climate of the region is given by the following statistics for Sault Ste. Marie, Ontario, and Sault Ste. Marie, Michigan, as extracted from Hosie (loc. cit.). February is the coldest month with an average temperature (over 20 years) of 12°F. and a minimum average of 53°F. The average date of the last killing frost in spring is May 15 (U.S. side of the St. Mary's River) and the latest killing frost recorded in 33 years is May 29. The first killing frost in the autumn averages September 28 with the earliest on September 5. The above gives an average growing season of 136 days. The annual precipitation at Sault Ste. Marie (Ontario) is 23.58 inches of rain and 97.8 inches of snow, giving a total precipitation of 33.36 inches falling largely in the growing season.

PREVIOUS NATURAL HISTORY INVESTIGATIONS

Although the mammal, bird, reptile and amphibian life of the Sault Ste. Marie region had not been surveyed and these forms catalogued previously, there are a number of reports of a limited nature in the literature. Those which pertain to the subject matter covered by each of the following papers will be cited therein. There is at least one publication which concerns the natural history of the general region but it does not treat of our area extensively. We refer to an early account by L. A. Agassiz (1850) which describes the physical character, vegetation and animal life of the Lake Superior region generally. Specific reference to the Sault Ste. Marie region is to be found therein. Three other papers report entirely, or principally, on animals other than those with which we are dealing. Two are entomological papers which report on forms found in the vicinity of Sault Ste. Marie. The first (Preece, 1924a) concerns sphinx moths; the second (Preece, 1924b) records certain red-underwing moths. The third is that of Williamson (1907) who presented the results of a collecting trip near Sault Ste. Marie. This paper deals with plants, bivalves, crayfishes, reptiles and batrachians, and several groups of insects.

The following citations deal with birds found in the Sault Ste. Marie Region, Ontario, during seasons other than summer and consequently will not be referred to in the bird report: Preece (1923) records a male Cardinal taken near the Goulais Bay–Bellevue Road on November 7, 1923; and Beebe (1933) points out the influence of the upper Great Lakes in concentrating bird migrants in the general region with which we are concerned. There are of course numerous faunal notes and papers dealing with localities in peninsular Michigan. Most of these will not be cited in the following papers.

L. L. S.

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MAMMALS OF THE SAULT STE. MARIE REGION

By L. L. SNYDER

The major portion of our mammal survey, accomplished during the summer of 1931, was conducted by Mr. D. A. MacLulich to whom the Museum's thanks are due. The work was furthered, however, by the valued co-operation of Prof. A. F. Coventry who joined the party on July 7 and remained until the 27th. Our appreciation is here extended to him. In addition co-operation and reciprocal procedure in the field among all members of our party produced considerable data and specimens and therefore thanks are due to Messrs. Baillie, Edmonds, Logier and Shortt. Even Mrs. McSorley, who so ably served as cook, should be acknowledged as the only mammal trapper present who could outwit and produce the remains of a particularly smart *Rattus norvegicus* which frequented our camp site. Although we felt chagrin, the situation was understandable when the fact was divulged that she had used a sample of her culinary art as a lure.

The following annotated list records the occurrence, past and present, of thirty-eight species of mammals within the area surveyed. Twenty-two species listed are substantiated by one or more collected specimens each. No attempt was made to ascertain the relative density of small mammal populations in the various habitats. Trap lines were set in promising situations irrespective of prevailing weather with the simple purpose of producing a catch. Record of 3,900 trap-nights produced approximately a 5½ per cent catch, which conveys a rough idea of the prevalence of small mammals in the region during the summer of 1931. The total number of mammal specimens preserved was 276.

The arrangement of the following list is that of Simpson (1931) down to Families. Miller (1924) has been followed within each Family.

No final opinion has been presented on the racial identity of the specimens collected. Certain average measurements which may be of use in comparative inquiries have been noted. These are in millimetres and grammes. If measurements of males and females have indicated no significant difference between them, they have been averaged together. The symbols used are as follows: L = total length; T = tail length, not including the hair; H.F. = length of hind foot, including claw; Wt. = weight.

Sorex cinereus. CINEREOUS SHREW.—The summer of 1931 was not one marking great abundance of this animal but it was taken regularly throughout the summer. Most specimens were caught at night although one was taken during daytime. The majority secured was taken from low, wet ground with an overgrowth of alder and willow. The next most frequented habitat was sphagnum-covered ground with an overgrowth of black spruce or white cedar. One specimen was caught on a small sand and mud bar in a stream flowing through a dense old hardwood forest. This trap-line was one of the several set to secure *Sorex palustris*, a species we did not procure during the entire summer. Incidentally, we did not secure specimens of *Microsorex hoyi* either. Both of these shrews were taken by Clarke (1938) only a few miles to the north which indicates that further collecting in the Sault Ste. Marie region will probably produce these species.

Only one of the five females of *S. cinereus* secured was pregnant. This specimen was collected on July 22; there were three embryos.

The average measurements of the seventeen specimens collected are: L. 100.8, T. 40.7, H.F. 11.6, and the average weight of six is 4.

Sorex fumeus. SMOKY SHREW.—Throughout the month of June and until mid-July our trap-lines did not yield the Smoky Shrew and, in 1931, we did not suspect that the range of *fumeus* extended into this part of Ontario. On July 16 the first specimen was taken by Professor Coventry at the foot of a talus slide just within the border of a tall, mixed stand of trees. During the remainder of July four other specimens were secured. All but one were taken either at the original site, or in a similar habitat in the same general locality. The exception, a nursing female, collected near MacLennan on July 25, was secured in a balsam stand remnant in a recently made clearing. Mt. T. M. Shortt saw the animal enter a hole in the ground beneath a brush pile, at dusk. A trap set at the entrance yielded the specimen. It is possible that the distribution of this shrew in the region is sporadic even during years when it is most numerous.

The tail of a male taken on July 20 was conspicuously swollen (3 mm., greatest diameter), a condition assumed to be associated with the mating period. The average measurements of five adult specimens are: L. 110.6, T. 47.6, H.F. 13.3, Wt. 7.2.

Blarina brevicauda. MOLE SHREW.—We did not capture a large number of Mole Shrews during the summer of 1931, but specimens were taken fairly regularly and the species was found to occupy a considerable variety of habitats. They were found in alder-willow-ash flats, alder-Scirpus shores (for which they showed a slight preference according to trapping frequency), old hardwood forests, poplar woods with white spruce undercover, and talus slopes. Moist soil, root tangles and mossy logs fulfilled the requirements for immediate cover. On two occasions an individual was observed to be active during daytime. The average measurements of nine specimens which appear to have reached sexual maturity are: L. 120.5, T. 27.8, H.F. 15.6 and the average weight of five is 19.7.

Parascalops breweri. HAIRY-TAILED MOLE.—We learned from local residents that a large mole "without a fringe on its nose" occurred in the region. Definite evidence was available in the small collection of mammals of Mr. Arthur Caron of Sault Ste. Marie, in which there is a specimen taken in Korah Township in the fall of 1930. More recently Clarke (1938) reports that as many as fifteen Hairy-tailed Moles were said to have been taken in a city garden in Sault Ste. Marie. Records of this species from contiguous areas to the south (Michigan) have not been found so it would seem that the discovery of this mole in the Sault Ste. Marie region can be regarded as a western extension of its range by more than two hundred miles. The nearest specimen record known to the writer is one in the R.O.M.Z. from Seguin Falls, Parry Sound District, Ontario.

Condylura cristata. STAR-NOSED MOLE.—This mammal was fairly generally known to residents of the region, not for reasons of its conspicuousness but because the curious fringe of fleshy processes about its nose impressed the observer when one was examined in detail. A specimen captured alive on June 22 in Jocelyn Township, St. Joseph Island, by Mr. Logier was secured in low, wet terrain overgrown with scrub willows bordering a small lake. When it was encased in a muslin bag and grasped in the hand one had considerable difficulty in holding it. The great strength of the fore-limbs was most impressive and also it was noticed that its hair, in effect, presented a slippery surface. At no time did the mole attempt to bite one's hand; apparently its most dependable aid in defense was rapid burrowing, unless its acrid gland secretion served it protectively. The odour, which suggested one of vegetable origin, was noticeable while one was handling the animal. Closer inspection with the nose gave the impression that it might well be repellent to carnivors. The odour is still faintly noticeable on the specimen which has been preserved as a dry skin for ten years.

Although this species apparently was not plentiful during the year of our visit, "diggings" attributed to it, were occasionally noted in the field. None was captured in our trap lines though sets were frequently made in suitable situations.

The specimen secured was a male, the measurements of which are as follows: L. 180, T. 75, H.F. 31, Wt. 43.

Myotis lucifugus. LITTLE BROWN BAT.—Although the fortunes of bat collecting did not favour us as regards the variety of forms secured, something approaching an adequate representation of *M. lucifugus* accrued. A local resident, Mr. Henry Reid, discovered a colony of bats located within the roof of his house. By placing a dark bag over the exit in daylight the animals were induced to enter the bag. Thus, on July 10, a total of 64 bats was secured, all of which proved to be of this species. The colony was found to be composed entirely of adult females and young. Thirty-six specimens were preserved as dry skins. There was a rather wide range in size among the young of the colony. The smallest was not much larger in body bulk than a thimble (weight, 2.2 gms.) and still exhibited a prominent umbilicus, while the older ones were but slightly smaller than adults.

During the preparation of specimens the mammary glands of lactating females were observed to be greatly developed and it is of interest to note that these glands occupy a distinctly lateral position, even lapping around to near the mid-dorsal line and occupying a position equidistant from the shoulder and hip. The position of the nipple too was distinctly lateral. No doubt this is a most convenient arrangement both for the young and the adult, when nursing young accompany the parent on aerial excursions.

Although we did not obtain definite evidence of the occurrence of other species of bats, some may occur, such as *Myotis keeni*, *Lasionycteris noctivagans* and *Nycteris borealis*. These species have been recorded by Clarke (1938) from Pancake Bay.

The average measurements of thirteen mature specimens preserved are: L. 90.4, T. 3.5, H.F. 10.3, Ear 12.5, Tragus 5.5, wing-spread 251, Wt. 7.9.

Lepus americanus. VARYING HARE.—Clearing of the land within the area we surveyed has certainly reduced the extent of habitat suited to the Varying Hare. There are still extensive tracts, however, in which it lives. During the summer of 1931, the species was not at a peak of numbers but we noted it regularly, one to three having been recorded on about 25 per cent of the days spent afield. The previous period during which the Varying Hare had been markedly plentiful was about 1924 according to residents. Subsequent reports have shown a numerical peak in the Sault Ste. Marie region during the winter of 1933-34 (MacLulich, 1937).

The first young of the year were observed on June 4. One seen on that date was already about half-grown. The average measurements of two adult specimens preserved are: L. 441, T. 35, H.F. 132.

Marmota monax. WOODCHUCK.—This is one mammal which probably has been favoured by the advent of cultivation and deforestation in the area. It occurs in both dry, rocky clearings and farmland throughout the area. We found it fairly common during the summer of 1931; from one to four were recorded almost daily. On June 12, the writer saw three Woodchucks in close association, not more than five feet separating those farthest apart. This perhaps was a casual, or accidental, assemblage since they were all virtually mature; certainly none was young of the year and the date is too late for courtship visitations.

Of the six specimens preserved, four are obviously young, ranging in length from 411 mm. to 465 mm. The other two are apparently adults. The male measures as follows, L. 525, T. 137, H.F. 77. The measurements of the female are: L. 546, T. 134.5, H.F. 74.

Eutamias minimus. WESTERN CHIPMUNK.—In general the species was distributed throughout the region in 1931 but it showed a preference for certain habitats in some of which it was surprisingly plentiful. The most favoured habitat was about stumps and rail fences surrounding stony pastureland. The next most frequent habitat was among drift wood on sandy beaches, especially those fronting white pine sand plains. It was also found in clearings in the drier forests, especially where there were exposed rocks and scattered stumps and brush. Occasionally the species was seen in second growth poplar-birch stands but it was unusual or absent from heavy or wet forest. These facts suggest that the species is more widespread now than under primeval conditions and that it would extend its range along beaches and through burns and cut-over areas.

During the first three weeks of June, this species was seen less frequently than during the remainder of the summer. This is probably due to the confinement of females during the nursing period of early summer and the later emergence of young from the home nest.

The first young of the year were noted on June 23. A total of thirty-five specimens was preserved, adults and young. Twelve were males and twenty-three were females. No suggestion can be offered concerning the habits of these animals or the methods of collecting which would result in selective capture and account for the nearly two to one ratio of females to males. Two adult females collected were bob-tailed, one (June 23) as a result of a recently-sustained injury. The tail of this species is relatively longer than that of the Eastern Chipmunk. When frightened and while scampering to cover this organ is usually carried straight and upright at a right angle to the body which presents a somewhat ungraceful, even ludicrous appearance. The vocal sound produced by this species is a high-pitched, bird-like "tsip".

The average measurements of five adult males are: L. 205.7, T. 97.9, H.F. 31.1, Wt. 45. The averages of the females collected are: L. 213.8 (eight specimens), T. 100.4 (eight specimens), H.F. 31.9 (ten specimens), Wt. 57 (six specimens).

Tamias striatus. EASTERN CHIPMUNK.—This chipmunk was the commoner of the two species occurring in the region as a whole. It was observed regularly and plentifully throughout the area in a variety of wooded and open habitats. Our notes on habitats indicates its preference for hardwood forests, particularly at their edges and about clearings within, especially the maple-yellow birch, or maple-oak forests. However, the species was collected or observed in second growth birch-poplar, rocky clearings with slash, mixed birch-balsam, and even in moist sphagnum-alder situations.

The number observed daily was fairly consistent throughout the two months of our stay although the largest total (18) was reached on July 15. A relative scarcity in the early summer was not as noticeable with this species as it was with the Western Chipmunk.

According to our observations, the young of the eastern species appeared earlier in the season, the first being noticed on June 13, ten days earlier than young of *E. minimus.*

The collection of specimens secured consists of twelve adults and eight young. The sex ratio of the series of twenty specimens, which was collected without obvious selection, is equal, in the case of both adults and young. A specimen shot July 4 had it cheek-pouches filled with blueberries.

The average measurements of six adult males are: L. 244, T. 102.8, H.F. 35.8, Wt. 97.6. The adult females average as follows: L. 248.4, (five specimens), T. 98.2 (four specimens), H.F. 36.1 (six specimens), Wt. 103.1 (five specimens).

Tamiasciurus hudsonicus. RED SQUIRREL.—With the exception of the Eastern Chipmunk, the Red Squirrel was the most frequently recorded mammal on our daily observation and trapping list. It was observed every day we were in the field. It occurred in forested situations throughout the area. A slight preference for mixed woods was evident but it was found in many types of forest growth, from moist maple-birch to dry jack-red-white pine stands. The earliest date on which young of the year were noted was June 13. On this occasion three young were discovered in a hollow tree open at the base and at the top, a chimneyshaped bole standing in a hardwood forest. They ran out the top when the writer rapped on the trunk in search of nesting Chimney Swifts. A nursing female taken on July 8 was in worn winter coat. Of the series of fifteen specimens secured, thirteen are adults.

The average measurements of seven males are: L. 313.5, T. 119.8, H.F. 46.8, Wt. 185.2. The average linear measurements of six females are: L. 300.8, T. 121.6, H.F. 46.8 and the average weight of three is 171.3.

Glaucomys sabrinus. NORTHERN FLYING SQUIRREL.—It is difficult to arrive at any estimate of the numerical status of a nocturnal species such as the flying squirrel in summer. Three specimens were secured without special devices which suggests that this animal was not particularly scarce during 1931. One animal was taken from a situation overgrown with white elm, black ash and balsam; another was taken on a dry hillside in a balsam stand; and the third was taken from a damp woods of red maple, balsam and black spruce. Only one of the specimens is adult. It is a male which measures as follows: L. 274, T. 128, H.F. 40, Wt. 72.

Castor canadensis. BEAVER.—Since the area with which we are concerned became settled, the Beaver has not been particularly numerous but it has persisted particularly along the banks and around the islands of the St. Joseph River. One was seen in the river during our stay in the region and fresh beaver cuttings were found. Men who do local trapping in winter informed us that they secure an occasional Beaver but the only evidence of a recent increase in the population of this animal in the region concerns St. Joseph Island. In November of 1932 reports indicated that Beaver had increased; in fact, there were complaints in the press that beaver dams had flooded certain areas resulting in damage to township roads. Strangely enough an identical complaint from the vicinity of Desbarats was published in "Forest and Stream" for November, 1904.

Peromyscus maniculatus. WHITE-FOOTED MOUSE.—Not abundant but found to be fairly common and rather generally distributed through a variety of forest situations during the summer of 1931. Our data suggest that old talus slopes overgrown with moss and sheltered with birch and white pine approached being a favoured habitat of this species although no marked concentration was found there. Other wooded tracts, both damp and dry, were occupied by the White-footed Mouse. We collected about an equal number from balsam-spruce-poplar woods as from alder-willow-ash-elm overgrowth. Burned-over areas and old camp sites were also tabulated as productive sites in trapping operations.

The twenty-seven specimens in the collection consist of fifteen males and twelve females. Many very young animals captured were not preserved. Twenty-four of the specimens are adults or sexually mature young. By arranging this series on the basis of dorsal colour the specimens fall rather definitely into three groups. The first group, presumed to comprise the oldest individuals, is approximately "Sayal brown" in appearance above. The second group is more nearly "wood brown", and the third group closely approaches "drab". The drab group seems undoubtedly to be made up of the youngest animals, although, as has been remarked, they are sexually mature. None of this group was collected before July 8, on which date one was collected containing six embryos. The significance of the second group, specimens with a general dorsal aspect of "wood brown", is unknown. Specimens of this type were collected throughout the summer, from June 6 to July 26. One specimen collected on June 6 appears to be, at least in part, in winter coat.

The measurements of the three groups were averaged separately and no difference regarded as significant was found between the "Sayal brown" group and the "wood-brown" group. They were consequently averaged together and their measurements are as follows: L. 175.4, T. 87, H.F. 21, Wt. 22.8. The average measurements of the "drab" group (young) are as follows: L. 168.8, T. 77.2, H.F. 19.8, Wt. 18.2.

Synaptomys cooperi. COOPER'S LEMMING MOUSE.—A rather rare species of which only seven specimens were secured. All specimens were collected in moist woods and in every case the immediate habitat association included sphagnum moss. At least two distinctive tree associations constituted the gross cover of occupied habitat; alder-black spruce-tamarack and red maple-balsam fir-balsam poplar. Runways and holes in the moss, or ground, were characteristic signs of the presence of this species. Dissection of a young female (L. 103, Wt. 18) which, incidentally was collected during the forenoon, disclosed three embryos.

The average measurements of the five adult specimens are: L. 121.9, T. 19.7, H.F. 18.3, Wt. 30.

Clethrionomys gapperi. RED-BACKED MOUSE.—Fairly common during the summer of 1931; a series of thirty-four specimens was preserved (18 males and 16 females). Rather heavily forested situations appear to be preferred by this species and nearly all of our data indicate that immediate cover such as rocks, logs and moss, are essential elements in the habitat. There appeared to be a slight concentration of this species about talus slopes where tree-growth encroached over the outlying rim. The next most frequented habitat was moist, old, hardwood forests (maple-birch, etc.), wherein they lived about roots and fallen logs. Occasional specimens were taken in all but the more open and dry forest situations and the wettest bogs.

The first young animal collected was taken on June 6. In size it was about half the body bulk of an adult. By mid-July young of the year were sexually mature and producing young. Four embryos were noted in one female of this age group and five in another. The size of these young animals is indicated by the following averages: L. 131.7, T. 28.8, H.F. 19.7, Wt. 23.5. The fourteen specimens regarded as fully adult average: L. 151, T. 39.8, H.F. 20.5, Wt. 29 (thirteen specimens). An item of interest concerns the finding of small red mites (see Fraleigh, 1929) on the ears of most of the Red-backed mice we captured.

Microtus pennsylvanicus. MEADOW MOUSE.—Taken fairly regularly throughout the summer but not commonly in any particular habitat. The situations where the species was most frequently collected were the borders of Scirpus marshes along the shore of St. Joseph Channel and Lake St. George and wet flats beneath alder-willow and birch-balsam overgrowth. One young specimen was taken from a talus slope at the edge of woods and one from an alder-sphagnum swamp.

Of the twenty-six specimens preserved only five were fully mature animals and these were all males. Of the twelve sexually mature young specimens secured, seven were males and five were females. The remainder, made up of very young animals, comprised five males and four females. Though our facts are fragmentary they suggest that if an uneven sex ratio existed in the mature population an adjustment toward a more equal ratio was under way. The youngest pregnant female, still in the woolly coat, measured: L. 138, Wt. 27. Four uterine swellings about 7 mm. in diameter were noted when this specimen was dissected. Another pregnant immature specimen dissected disclosed five foetal young. The average measurements of the five adult males are as follows: L. 167.2, T. 46.3, H.F. 20.6, Wt. 44.2.

Microtus chrotorrhinus. YELLOW-CHEEKED VOLE.—Seven specimens were secured, six from old talus slopes where tree growth had encroached to, and even upon, its rim. The specimens were secured near the outer border of the talus where bulky material had been carried farthest out. Countless minute caves were found beneath the rocks in such situations which, having become partly overgrown with moss, effectively produced moist, cool micro-climates suited to the Yellow-cheeked Vole. The one specimen not taken on a talus slope was secured from a runway in the sphagnum in a black spruce bog on a high hill.

One young female (L. 157.5, Wt. 38) collected on July 26 was found to contain two well-developed young. A fully adult specimen contained five foetal young. Five specimens of the series collected can be regarded as adult, or nearly so. Their average measurements are: L. 168.5, T. 49.5, H.F. 20.5, Wt. (four specimens) 38.2.

Ondatra zibethica. MUSKRAT.—Trappers who restrict their activities to the area with which we are concerned depend largely on the Muskrat yield each year. The marshes of St. Joseph Island are among the best local trapping stations according to reports. We observed the species occasionally in the cat-tail marshes bordering the St. Joseph Channel, and noted the runways and dens of bank-dwellers along streams and along shores fronted by *Scirpus* marshes. A skull-specimen from the Garden River Indian Reserve was preserved.

Rattus norvegicus. HOUSE RAT.—Since our camp during the summer of 1931 was on a vacant farm several observations of this species were made about the buildings. The species is to be expected throughout settled sections. We were not able to obtain any exact information as to the advent of this creature into the region. Obviously it has been there many years.

The adult male specimen collected measured: L. 378, T. 155.5, H.F. 41, Wt. 240.

Mus musculus. HOUSE MOUSE.—Distributed generally through settled portions of the area surveyed. Although usually found in or about buildings, the species wanders afield somewhat. One specimen collected on the bank of the Iron River was approximately a quarter of a mile from the nearest building.

The average measurements of three adults collected are: L. 167.7, T. 78.5, H.F. 18.5 and the weight of one was 14.

Zapus hudsonius. MEADOW JUMPING MOUSE.—Six specimens were collected in mouse traps during the summer of 1931 suggesting that the Meadow Jumping Mouse was not particularly rare that year. Two types of habitat recorded appear to indicate a preference for more open moist situations. Three specimens were taken from wet sedge and grass swales in farmland and two from wet alder-willow flats. One young animal was taken on a mud-sand bar on a small stream overhung with old mixed woods.

The average measurements of the adults are: L. 213.5 (four specimens), T. 132.8 (four specimens), H.F. 30.6 (five specimens), Wt. 18.8.

Napaeozapus insignis. WOODLAND JUMPING MOUSE.—Our one record of this species during the summer of 1931 indicates that it was not common in the area during that summer. The specimen secured was not taken until July 25th after almost two months of trapping the varied habitats of the region. It was captured in a dry tangled brulé beneath a thicket of young aspen poplar, bird cherry and scrub willow.

The specimen, an adult female, is notably bright ochraceous tawny along its sides. It is somewhat more highly coloured than is characteristic of *N. i. abietorum* but equals large specimens of that form in size. The specimen therefore suggests some influence of both *abietorum* and the newly described form, *N. i. algonquinensis* (Prince 1941).

Measurements of the specimen are: L. 262, T. 167, H.F. 31.5, Wt. 27.

Erethizon dorsatum. PORCUPINE.—Observed regularly but not commonly throughout the summer. Fourteen dens of this species were discovered, one in moist ground among roots of old White Cedars and the others in crevices among rocks of old talus slopes in the forest. They were all cool and humid. Near these dens porcupine excreta were observed, usually in rather large and conspicuous deposits, attesting to the den sanitation of these animals and indicating their behaviour in repeatedly using one situation near the entrance for defecation.

On July 9, Messrs. Coventry and MacLulich observed a female porcupine and her one young which was about one-third grown. When discovered the animals were in a den. The parent deserted the youngster and slowly climbed a tree. They observed closely the functioning of the tail in climbing. The distal portion was arched down, pressed against the tree-trunk. When muscular pressure straightened the tail, the animal was raised about three inches. The young porcupine was also observed to climb in this manner but with more rapid movements.

The specimen collected (disclosing two fairly-small embryos when dissected) was feeding on elm leaves. It measured: L. 688, T. 210, H.F. 100.

Vulpes fulva. RED FOX.—One of the more dependable fur-bearers taken locally by trappers in winter but subject to periodic variation in numbers. A den of this species was found during the summer of our visit but no foxes were observed.

Canis latrans. BRUSH WOLF.—Most of the residents did not distinguish between the Brush Wolf and the Timber Wolf but trappers assured us that both occur. Mr. Hugh Erwin, a farmer with whom we were neighbours during our 1931 camp near Maclennan, told us he moved to the region in 1886 and at that time there were no wolves of any kind in the district. This is consistent with the general conception of the movements of the Brush Wolf in Ontario. He gave the year 1912 as the first when "wolves" came in, as he thought, from Michigan. Since then, "wolves" have become more widespread and certainly at times numerous. They first became troublesome about 1921. Some farmers discontinued raising sheep in the district because of "wolves". Both ewes and lambs are attacked. Mr. L. G. Davidson lost 28 fully-mature ewes out of a flock of 51 in the winter of 1921-22. In 1925 another farmer lost 15 sheep, seven in one night. There has been both summer and winter loss. Although it is not possible to designate the species of wolf involved, it seems probable that both wolves which occur in the region are capable of destroying sheep. We were told of "two or three" young Brush Wolves being found on Pine Island near our camp in the early summer of 1929. None was seen by our party during 1931.

Canis lupus. TIMBER WOLF.—Local trappers state that this species occurs within the area of our survey as well as the Brush Wolf. The general opinion of residents of the region is that big wolves are usually found more to the north, less frequently in the cultivated section with which we are concerned. Clarke (1938) records that Timber Wolves were "common enough up Goulais river where the writer spent the summer of 1928 in the region now included in the Goulais game preserve." This district is adjacent to our area.

As mentioned in connection with the Brush Wolf, Mr. Hugh Erwin gave it as his opinion that no kind of wolf was present in the farming district in 1886. This is a possibility and seems certainly to be true of the Brush Wolf. The larger Timber Wolf may not have been prevalen at that time, although it would seem certainly that the area was within its range.

Ursus americanus. BLACK BEAR.—Bears are observed fairly regularly in the Sault Ste. Marie region. These may be largely seasonal wanderers from the unsettled north but there are still areas within the limits of our survey where bears occur throughout the year. The vast swamp on St. Joseph Island, for example, no doubt harbours the species the year round. Tracks were observed by us on two occasions during the summer of 1931. On June 16 school boys at Maclennan reported that a "brown" bear was seen in a woodlot adjacent to the school grounds on that day. Also, the writer was informed by Mr. J. Savage, a student at the University of Toronto, that on August 27, 1933, he inspected two captive bear cubs at Sault Ste. Marie which were said to have been captured near Batchawana. Mr. Savage stated that these animals were of the cinnamon colour variety. Black is, however, the normal and usual colour to be expected in the region. In fact, we talked with trappers who had never seen bears which were brown in colour.

Martes americana. MARTEN.—Reports of trappers in the region all agree that marten are virtually extirpated in the Sault Ste. Marie region. Occurrences of this species within recent years are rare indeed. Mr. James C. Fisher took one in 1921 and Mr. L. G. Davidson saw one in his farm woodlot, near the St. Joseph Channel at Maclennan, in 1925 or 1926. Seton (1909) refers to a female with four young observed by George Linklater of Desbarats many years ago, possibly within the territory of our survey.

Martes pennanti. FISHER.—This fur-bearer has also become very rare but an occasional wandering animal is taken within the area with which we are concerned. Mr. Wm. A. Boyer, a commercial trapper, told us he still obtains fisher regularly, but not plentifully, inland, in sections adjacent to the Sault Ste. Marie region and Clarke (1938) states that they "still occur in the Pancake region."

Mustela cicognanii. BONAPARTE WEASEL.—Mr. Lawrence Mannard and other trappers who confine their activities to the more settled sections of this region find weasels one of the most frequent takes on their trap-lines but the annual catch varies from year to year. Description of the weasels captured made it evident that *cicognanii* was the species taken regularly. No trapper interviewed knew a very small weasel without a black tail-tip. Our enquiry was prompted by a northern Algoma District record of *M. rixosa* (Snyder, 1935).

Mustela vison. MINK.—This species, on the average, rates about fourth numerically, in the catch of local trappers. St. Joseph Island and the shores and islands of St. Joseph Channel are still good trapping grounds for Mink. Aside from signs, we observed the animal only twice during the summer of 1931. We were told of a "black mink" taken on the Echo River several years ago. Of historic interest is a drawing by Seton (1909, p. 874) of the head of a young Mink from Desbarats, which is within the area of our survey.

Lutra canadensis. OTTER.—Mr. James Perry, who has lived and trapped the region since 1906, stated that his only knowledge of the occurrence of this animal was one taken about 1911 on St. Joseph Island and another seen near Nevill's Island (St. Joseph Channel) in 1929. These are our only records.

Mephitis mephitis. SKUNK.—Observed, or otherwise noted by us, regularly throughout June, 1931, less commonly during July. The Skunk is perhaps the third most numerous fur-bearer in the Sault Ste. Marie region.

The average measurements of two adult females collected are: L. 554, T. 209.5, H.F. 67.5.

Lynx canadensis. CANADA LYNX.—We were told of a lynx having been taken on the "lower end of St. Joseph Island about 1913." The report presumably applies to this species. Any other information we secured concerns the unsettled hinterland to the north where commercial trappers must now go to secure fur other than Muskrat, Weasel, Skunk, Mink and Fox.

Cervus canadensis. WAPITI.—The Wapiti, or American Elk, has no place in the native fauna of the Sault Ste. Marie region, historic or present. It is included here because the species was introduced into the area. In 1934, fifteen females and five males from Wainwright Park in Alberta were released near Glendale. These animals rapidly disappeared. The last one noted, so far as the writer is aware, was in January 1935, when a lone animal was reported feeding at a haystack in a farmer's field near the point of introduction.

Odocoileus virginianus. WHITE-TAILED DEER.—Mr. Frank Shewfelt, who has lived in the Sault Ste. Marie region since 1879, told us that deer were first seen there about 1887. This approximate time was verified by Mr. Hugh Erwin who moved to the area in 1886. Mr. Erwin stated that it was his belief that deer had not been seen up to the time he settled there but that very shortly afterward a few were reported. It was generally understood that they came from Michigan.

Signs of White-tailed Deer were noted regularly by us during the summer of 1931 and a few animals were seen.

Alces americana. MOOSE.—According to the recollections of Mr. Frank Shewfelt and Mr. Hugh Erwin, long-time residents of the area, Moose did not inhabit the Sault Ste. Marie region in 1886. They were both of the opinion that Moose came in from Michigan "following the White-tailed Deer," about 1889. An explanation of this situation would seem to be in the erratic and changing local distribution of this species, since the Sault Ste. Marie region must be regarded as within the general range of the species in recent historic times. A record on file in the R.O.M.Z. concerns a "head" taken in the Sault Ste. Marie region in 1904. Mr. Joseph Towley states that this animal had a spread of fifty-one inches. Moose were also referred to as a game animal of the Desbarats area in "Rod and Gun in Canada" in a September, 1905 issue (p. 440). At the present time, Moose wander into the settled area with which we are concerned. We saw tracks on three occasions in 1931 and one animal was reported as seen near Maclennan on June 12.

Rangifer caribou. WOODLAND CARIBOU.—It seems apparent that many years ago, before settlement, Woodland Caribou occupied some of the islands of the St. Mary River and the St. Joseph Channel, and that they must have once travelled through the area of our 1931 survey. Mr. James C. Perry told us that a small island on the Michigan side was known, at least locally, as Caribou Island. A lake east and north of Desbarats is named Caribou Lake. Mr. Hugh Erwin told us that an occasional caribou was said to be present in 1886 when he first settled there but it was prior to 1870 that they occurred with any frequency. In a letter on file in the R.O.M.Z., dated Nov. 26, 1904, Mr. Joseph Towley wrote to the late J. H. Fleming, from Sault Ste. Marie, as follows: "You were asking about Caribou: They are quite plentiful on a range of hills fourteen miles north of the Soo; also on a range back of Echo Bay and Garden River, but I do not know of any points south of those mentioned. They follow the highest ranges as a rule." Clarke (1938) states that according to old settlers the Pancake area was once a fine caribou country. In the Toronto "Mail and Empire" for October 8, 1931, and in the Toronto "Telegram" for March 15, 1934, reports indicated an increase in Woodland Caribou to the north in this general section of Ontario. But, it is not to be expected that this splendid animal will return to the immediate Sault Ste. Marie area.

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SUMMER BIRDS OF THE SAULT STE. MARIE REGION, ONTARIO

By L. L. SNYDER

The following annotated list is based largely on the Museum's field work carried on during June and July of 1931. The reader is referred to the General Introduction for a description of the area and for a delineation of the boundaries of our survey.

During this and all previous faunal surveys made by the Museum there has been reciprocal aid between workers in the field. Therefore, thanks are due to all members of the party, but to Mr. T. M. Shortt who observed and collected birds throughout the summer, to Mr. John Edmonds, who spent more time with bird-work than with mammal-work, and to Mr. J. L. Baillie who contributed principally to bird-work after his arrival on July 3, special acknowledgment is due.

Since the summer of 1931, Mr. Harry Graham, a resident of Sault Ste. Marie, has made many observations on the breeding birds and forwarded particulars for our files. Many of his records are included in this report and we take this opportunity to thank him for his contributions.

There are a number of references in our ornithological literature which pertain to birds of the Sault Ste. Marie region and contiguous areas, especially concerning adjacent sections of the United States. No attempt has been made to compile and include a complete bibliography, primarily because we are concerned here with birds found in summer. Such references as have been cited are listed at the end of the paper.

Our collection of summer birds from the Sault Ste. Marie region comprises 398 specimens representing 104 species. The total of species included in the following list is 133. We have been able to establish satisfactory breeding evidence for 92 of these. In the catalogue of specimens the year in every case is 1931.

The arrangement of the list follows the American Ornithologists' Union Check-List (1931 edition) and the English specific names are from "Birds of Canada" by P. A. Taverner.

Gavia immer. COMMON LOON.—Breeding pairs of Common Loons were established along the shores and about the islands of the North Channel, along the St. Joseph River, the bays of Lake Superior, and the larger inland lakes. The earliest date on which young were seen was June 30 when a family group was recorded at Island Lake; parent birds were escorting two nestlings of small size in their first dark downy plumage. A nest found near the water on the shore of Maskinonge Bay near Maclennan on June 24 contained one egg which had failed to hatch and the broken shell of another, from which a young bird had emerged very recently.

Podilymbus podiceps. PIED-BILLED GREBE.—Observed throughout the summer whenever suitable areas were reconnoitred. From one to six adults were noted in the several occupied situations discovered. Twice, in separate areas, young of the year augmented daily totals to nine. Young had hatched and left a nest found on June 24 near Maclennan and downy young about half-grown (one weighing 247 grms.) were secured on July 13. We have since received details from Mr. Harry Graham of a nest of this species containing six eggs found in a marsh of Maskinonge Bay on June 28, 1937.

Downy ♀ July 13, Point au Pins   Downy ? July 13, Point aux Pins

Phalacrocorax auritus. DOUBLE-CRESTED CORMORANT. — A small nesting colony of this species is established "on an island in the North Channel near Thessalon and another on a smaller rock near by" according to information supplied us by the late Wm. I. Lyon, who banded birds in this area during several summers. We had no opportunity to visit these colonies during 1931.

Ardea herodias. GREAT BLUE HERON.—From one to six individuals of this species were observed daily during the summer of 1931, with occasional totals as high as twenty-seven. It was noted in situations scattered throughout the area, from Little Rapids to Goulais Bay. A small colony consisting of three nests, occupied by young, was found on July 9 at Pumpkin Point near the shore of Lake George. The site was in an elm-ash forest. There were probably other nesting colonies within the area of our survey undiscovered by us.

A demonstration of how a high degree of special development can be a handicap under certain circumstances was observed in connection with the Great Blue Heron. The species is undoubtedly beautifully adapted as a wader. Its long legs and neck and its deliberate and composed manner serves it well in its stealthy search for prey in shallow water, but constitute poor equipment for aerial combat. On July 9, Mr. T. M. Shortt and the writer observed a Herring Gull chasing a Great Blue Heron along shore at Lake George. When first seen the heron was flying slowly with characteristic dignity about fifteen or twenty feet above the water, its neck folded in, and its legs extended rearward. The gull was next observed to be in hot pursuit. Overtaking the heron from above the gull made a diving attack. The heron's steady wing-strokes, its even coasting gait, and the nice adjustment of its legs and neck abruptly changed to a confusion of impedimenta. The bird seemed to be falling apart. To the accompaniment of guttural squawks the great wings beat frantically, the legs dangled and kicked helplessly, and the serpentine neck extended and writhed in the heron's apparent effort to ward off its attacker. As the gull wheeled upward, the heron literally pulled itself together and regained its gait and composure, but time after time the attack was repeated and on each occasion the heron exhibited the same lack of dexterity and co-ordination in aerial defence. Surely, if the gull had been a mortal foe, the heron would have been an easy victim. We could not offer an explanation for the unsocial behaviour of the gull.

♀ June 8, Laird
Juv. ♂ July 9, Pumpkin Point

Botaurus lentiginosus. AMERICAN BITTERN.—Not plentiful but one or two usually were noted whenever suitable habitat areas were visited. Several young bitterns apparently constituting a brood were observed on July 27 in a marshy border of the shore of Maskinonge Bay.

♂ June 26, Maclennan

Ixobrychus exilis. LEAST BITTERN.—A pair of Least Bitterns was established in the marshy border of Maskinonge Bay during the summer of 1931. Mr. Harry Graham found a nest with five eggs in the same section of the area on July 7, 1941. These records fall approximately on the northern limits of range of the species and extend its known range in Ontario westward approximately 150 miles.

♀ June 20, Maclennan

Anas rubripes. BLACK DUCK.—We observed this species occasionally and noted that apparently suitable habitat existed here and there throughout the area. Five young, still in downy plumage, were observed on Lake George on July 9. Families were observed more commonly during late July, five such groups totalling thirty birds having been observed on July 27. Mr. Harry Graham found a parent with her brood within the city limits of Sault Ste. Marie on June 29, 1939. Although we cannot say on the above evidence that the Black Duck was plentiful in the Sault Ste. Marie region, it was the most common duck and the area probably supports a larger population than our record indicate.

Downy ♀ June 26, Maclennan
Juv. ♀ July 9, Laird
Juv. ♂ July 9, Laird
♀ July 9, Laird
♀ July 10, Laird

Nyroca collaris. RING-NECKED DUCK.—A male was observed at Gordon Lake on June 29. This summer occurrence coincides with the period during which this species began to be reported as breeding in more easterly sections of North America.

Glaucionetta clangula. COMMON GOLDEN-EYE.—Observed occasionally along the shores and islands of the St. Joseph portion of the North Channel and Lake George. An occupied nesting hole, from which a female was flushed on two occasions, was situated near the top of an old rampike at least fifty feet from the ground. The situation was fully one hundred yards from the water. The elevation of the nest and the distance to water would seem certainly to present two pronounced difficulties for newly-hatched young to surmount. The average number of young in the families encountered was nine.

2 downy ♀♀ July 9, Laird 3 downy ♂♂ July 9, Laird

Lophodytes cucullatus. HOODED MERGANSER.—The Sault Ste. Marie region is within the range of this species but we did not observe it during the summer of 1931. Cabot (Agassiz, 1850), however, records that a young one was shot from a flock in a creek at Point aux Pins, within our area, on June 30, 1848.

Mergus merganser. COMMON MERGANSER.—Observed occasionally along the St. Joseph Channel and at Echo Bay of Lake George. Mr. Baillie observed twenty-eight nearly full-grown young with one adult female at the latter locality on July 24.

Downy ♂ June 13, Laird

Astur atricapillus. AMERICAN GOSHAWK.—On June 22 our party, travelling by automobile along a woodland road on St. Joseph Island, flushed a Goshawk at close range from the road ahead. As the hawk flew off through the lower branches of dense forest, its dark mask, blue-gray upper parts, size, flight, etc., revealed its identity. The species was not observed elsewhere in the region.

Accipiter striatus. SHARP-SHINNED HAWK.—A rare summer resident of the region; noted on only two occasions by us.

Accipiter cooperi. COOPER'S HAWK.—Rather scarce but individuals were noted in various sections of the area visited, more regularly toward the end of the summer. On July 24 the writer was impressed by the complete quiet which descended over a woods when a Cooper's Hawk dashed past. Not a bird song could be heard for nearly four minutes, after which a Red-eyed Vireo, rather hesitatingly, resumed its measured phrases.

Buteo borealis. RED-TAILED HAWK.—Noted occasionally in widely-separated sections of the area, Gordon Lake, Maclennan, Iron River and Bellevue. A pair of Red-tailed Hawks reared its family in a nest situated on a ledge high up on the rock cliffs at Iron River. The nest, from fairly close inspection, appeared as characteristically bulky as one built in a normal arboreal site.

Buteo platypterus. BROAD-WINGED HAWK.—A fairly common hawk of the region; from one to four noted nearly every day throughout the summer. Immatures in streaked plumage were observed on June 17. These were probably one-year-old birds. The female taken by Mr. Edmonds on July 20 was uttering the characteristic call of the species when first seen.

♀ June 17, Maclennan ♀ July 20, Little Rapids

Haliaeetus leucocephalus. BALD EAGLE.—Twice during the summer a Bald Eagle was seen about Maskinonge Bay, probably the same individual. No nesting sites were discovered by us and none was known to residents of the region so far as we could determine. An adult seen during the summer of 1889 at Echo Lake is on record ("Kingfisher", 1889).

Circus hudsonius. MARSH HAWK.—The commonest hawk of the region. June 24 was the earliest date on which we noted young of the year out of the nest.

Pandion haliaetus. OSPREY.—Observed fairly regularly but not commonly about the shallower bays of the larger bodies of water. A pair nested near the base of Long Point, which lies at the northwestern end of Maskinonge Bay of the St. Joseph Channel, during the summer of our visit. Here we sometimes watched the parent birds dive in the bay for fish which they carried to the nest. Bull-heads were among the fish known to be captured.

As a matter of record, an item inscribed on the label of the specimen collected states that its intestinal tract measured twelve feet and one inch, from stomach to anus.

♀ June 8, Laird

Falco peregrinus. PEREGRINE FALCON.—Rare in the region. One was seen at Rydalbank on June 30 and a pair was found established on a high rock cliff at Garden River. We were unsuccessful in locating a nesting ledge from our position below but all circumstances suggested that this pair of birds was established there for nesting.

Falco columbarius. PIGEON HAWK.—One definite record of this species was made on the shore of Lake George on July 9. One bird was observed.

Falco sparverius. AMERICAN SPARROW HAWK.—Not uncommon; observed regularly about barns and open wooded pastureland. Among the notes forwarded by Mr. Harry Graham, he reports the finding of a nest of this species, discovered at Maskinonge Bay on July 16, 1939. Young were still in the nesting cavity on that date.

♂ June 12, Laird ♂ June 25, Maclennan

Canachites canadensis. SPRUCE GROUSE.—During the summer of 1931 none of our party observed Spruce Grouse in any section but reports from hunters and others interested in wildlife all agree that it occurs rarely. Experience has fully demonstrated to us that this species can exist sparsely in an area in summer and not be in the least conspicuous.

Although the R.O.M.Z. annual questionnaire attempts to obtain information on birds for the fall and winter periods only, reports from the Sault Ste. Marie region have been consulted concerning this non-migratory species. Observers from Batchawana Bay on Lake Superior to Thessalon agree that the species was scarce in 1939 and 1940. The largest number observed within this area was nine, tabulated by Mr. Roy V. Maguire, in the vicinity of Rydal Bank during the fall and early winter of 1940-41. Dr. C. H. D. Clarke observed the species (Ms) in the Goulais River valley between May 24 and September 22, 1928.

Bonasa umbellus. RUFFED GROUSE.—Observed regularly throughout the summer of 1931. The first young of the year, a newly-hatched brood of about twelve, were observed on June 13. On June 18 these young were able to fly. The behaviour of the female parent of this brood was especially entertaining. While the young flushed, one or two at a time, and settled in scattered places, the hen stood erect with body plumage much depressed and the head crest elevated. Following this she puffed out her plumage, appeared to strut, clucked and emitted her curious "bzzzt" notes. At times she flattened herself along the ground with neck and head thrust out and repeatedly "mewed and hissed."

A nest with eggs was found as late as June 16 in 1931. By the last week of June grouse incubation was apparently complete. Families were noted regularly thereafter. An interesting news item originating from Sault Ste. Marie on October 3, 1932, states that a Ruffed Grouse shot there had eaten a fourteen-inch Garter Snake. The snake was being swallowed and digested by degrees. The writer can attest to the probable accuracy of this report, having observed such an incident.

♂ June 8, Laird
Downy ♂ June 13, Laird
Downy ♂ June 22, Jocelyn
♀ July 13, Point aux Pins
Juv. ♂ July 15, Echo Bay
Juv. ♀ July 20, Rydal Bank

Perdix perdix. (European) Gray Partridge.—An importation of this species took place about May 1, 1930, when approximately 25 pairs were released five or six miles west of Sault Ste. Marie, near the Provincial Fish Hatchery. A news dispatch from Sault Ste. Marie dated January 13, 1931 (Toronto "Globe") reported that many of these birds had come close to the city, even "within the city limits." A similar report (Toronto "Telegram") dated December 2, 1933, states that "Hungarian Partridge have even ventured in the grounds of the City Hall." Obviously this introduction persisted for three years. No recent reports are available.

Phasianus colchicus. Common Pheasant.—Another species which has recently been introduced in the area. Few details relative to the success of its introduction are known to us. Residents we met in 1931 told us that pheasants had multiplied on St. Joseph Island and apparently were well established there. Mr. Wm. Murray, game warden of the district, told us he had observed pheasants near his home southeast of Maclennan prior to 1931. About 1929, Mr. L. G. Davidson saw one on his farm near Maclennan. An introduction was also reported at Bar River. Certainly pheasants had not flourished on the mainland up to the summer of 1931 since no member of our party observed the species. No recent reports are available.

Rallus limicola. Virginia Rail.—A pair was found established and breeding in a marshy border of Maskinonge Bay. This record is the most northern for the eastern half of our province and corresponds to the most northerly records in the upper peninsula of Michigan (Van Tyne, 1938).

Downy ♀ June 29, Maclennan
♀ June 29, Maclennan
♂ June 29, Maclennan

Porzana carolina. Sora Rail.—Observed near Maclennan and Gordon Lake. Probably the most numerous of the two rails recorded, but not plentiful. An historic record (Bell, 1861) concerns a male shot at Sault Ste. Marie, Aug. 30, 1860.

♂ June 29, Maclennan

Oxyechus vociferus. KILLDEER PLOVER.—A common breeding bird of the area, from one to twelve having been recorded daily throughout the summer. The hatching of young Killdeers was recorded from the time of our arrival until June 23. It was observed that both sexes of this species perform the broken-wing ruse when their nest or young are approached.

Downy ♂ June 7. Laird Downy ? June 23, Maclennan

Philohela minor. AMERICAN WOODCOCK.—Recorded on four occasions near Maclennan during the summer of 1931; the largest number observed on one day, June 5, was three. Considering the daytime reclusiveness of the species in summer, it is probable that Woodcocks are more plentiful than our actual records suggest. Bell (1861) states that they were numerous in August 1860 at Sault Ste. Marie.

Capella delicata. WILSON'S SNIPE.—Observed in wet swales in meadows near Maclennan and at Echo Bay. A young bird collected at the former locality, still with downy plumage about the head and neck and thighs, established a breeding record for the region. Six birds seen at Echo Bay on July 19 probably constituted a locally-reared family.

Juv. ♀ June 16, Maclennan ♀ June 16, Maclennan

Actitis macularia. SPOTTED SANDPIPER.—Not uncommon and observed in many sections of the area visited. Nests with full complements of eggs, fresh to slightly incubated, were found on June 9, 10 and 11, near Maclennan. On June 10 a wounded adult Spotted Sandpiper escaped by swimming rapidly away. When Mr. Edmonds, the observer, pursued it, the bird dived in a shallow part of Maskinonge Bay and was not seen to reappear on the surface.

♀ June 13, Laird ♂ July 15, Echo Lake

Pisobia minutilla. LEAST SANDPIPER.—This species occurs in the region in summer as a migrant and has no other status there. One was collected at Laird on July 9 and two were observed at Echo Bay on July 22.

♂ July 9, Laird

Larus argentatus. HERRING GULL.—Observed regularly and commonly along the coast and bays of the North Channel, Lake George and also along the rivers and about the larger inland lakes of the area. Most of the Herring Gulls observed during the early part of the summer were adults but there was a population of younger, non-breeding birds in the region at that time. Mr. George Sullivan of Desbarats, who knows the shores and islands of the North Channel perhaps better than anyone else in the district, stated that Herring Gulls nest in large numbers on "Grant Island" off Thessalon and also on Fox Island. According to a banding record in the Canadian Field-Naturalist (Nov. 1929, p. 193) another nesting site is probably situated on Court Point, St. Joseph Island. Young of the year in the dark plumage were observed by us late in the summer. A sick specimen dispatched by the writer on July 9 appeared to be suffering from a diseased condition of the intestinal tract.

♂ June 24, Maclennan ♀ July 9, Laird

Larus delawarensis. RING-BILLED GULL.—Throughout the greater part of the area the numbers of Ring-billed Gulls observed are much fewer than of Herring Gulls. Although we identified and recorded the species regularly, twelve was the largest daily total noted. If we could have visited the islands off Thessalon, we would have obtained a better conception of the population of this gull in the area. Mr. George Sullivan of Desbarats informed us that this species nests on "Grant" and Fox Islands.

♀ July 9, Laird

Sterna hirundo. COMMON TERN.—Observed fairly commonly in June but rarely in July. Mr. George Sullivan informed us that terns nest on "Grant Island" off Thessalon and Fox Island. On June 26, 1939, Mr. Harry Graham found a single nest of this species on Bayfield Rock in the St. Mary River.

Zenaidura macroura. MOURNING DOVE.—A rather rare breeding bird in the region. Mr. Hugh Erwin, a near neighbour to us in camp at Maclennan, told us that a pair nested in an apple tree on his farm in 1928 or 1929. Mr. Harry Graham found a new nest prior to egg deposition in a spruce tree near Maclennan on August 29, 1938.

♂ June 23, Hilton Beach

Ectopistes migratorius. PASSENGER PIGEON.—Certain records of this extinct species are of historic interest to this paper. It is evident that the Passenger Pigeon was a summer resident of the Sault Ste. Marie region. Henry (1809) says they were plentiful in the summer of 1762 and Cabot (Agassiz, 1850) saw some flocks at Point aux Pins on June 30, 1848.

Coccyzus erythropthalmus. BLACK-BILLED CUCKOO.—Our daily records show that the Black-billed Cuckoo was noted throughout the summer but only an occasional individual was observed prior to June 21.

Thereafter, until we left at the end of July, the species was observed more commonly and in all sections visited. As many as nine were recorded on a single day. Occasionally Black-billed Cuckoos were heard calling at night; the latest date on which night calling was noted was July 21 (11.30 p.m.). A nest with five eggs, reported to us, was found about June 30, near Maclennan, in a hazel shrub.

Although there is no evidence that the Yellow-billed Cuckoo (*Coccyzus americanus*) occurs in the region in summer, attention well may be drawn to two records in the literature: Preece (1924) mentions that the species has been observed, presumably, on migration at Sault Ste. Marie, Michigan; Pinney and MacNaughton (1937) report a September specimen taken in "Ontario, L. Superior, Michipicoten." According to Pinney (Ms.) the label on this specimen appears to indicate "Michipicoten Island," which is approximately one hundred miles northwest of the area with which we are concerned, and the date of capture is September 10, 1901.

♀ June 21, Maclennan	Juv. ♂ July 25, Maclennan
♀ July 9, Laird	

Otus asio. AMERICAN SCREECH OWL.—Although perhaps best included in this list hypothetically, Mr. Harry Graham has established sight records of this species during the summer months in the Sault Ste. Marie region. The nearest corroborative records are those of Clarke and Ricker (1939) from Lake Nipissing, Boies (1897) from Neebish Island (Mich.) and Van Tyne (1938) from Cheboygan County, Michigan.

Bubo virginianus. GREAT HORNED OWL.—Not a sight or sound record of this or any other species of owl was made by us during the summer of 1931. Undoubtedly the population of the Horned Owl was low that year. Mr. Harry Graham assures us that it occurs in the region *in summer* though he had no specific notes as to date. Other residents knew the owl by description and the Museum's questionnaire shows that it is present in autumn and winter. Dr. C. H. D. Clarke observed young ones on July 12, 1935, a few miles north of our area, at Batchawana Bay. (Baillie and Harrington, 1936.) On the basis of the combined circumstances mentioned above, the Great Horned Owl is included in our list.

Strix varia. BARRED OWL.—Although our data on this species are fragmentary such evidence as we have is of value. Cabot (Agassiz, 1850) saw it in the summer of 1848 at Sault Ste. Marie. Mr. Harry Graham writes that he has not discovered the species in the Sault Ste. Marie region in summer but knows that occasionally it occurs in autumn and early winter. Dr. C. H. D. Clarke met with it on July 31 at Carp Lake (near Batchawana Bay) somewhat north of the region covered by our report. If the species was found in summer in 1848 and occurs now in an area immediately adjacent, it may well be expected, perhaps rarely, as a breeding bird of the Sault Ste. Marie region.

Antrostomus vociferus. WHIP-POOR-WILL.—Although our records of this nocturnal species pertain largely to the vicinity of our camp near Maclennan, they possibly represent its status throughout much of the area. Whip-poor-wills were heard and seen regularly throughout the summer. From one to eight were recorded nearly every night. In addition to the Maclennan records they were noted at Sault Ste. Marie and Bar River. The female collected was giving the characteristic call of the species. This fact is mentioned because of its interest in connection with the theory of song and territory in current ornithology. That females of some other species "sing," or at least utter the vocal call of their kind, has not been reported commonly.

♀ July 25, Maclennan

Chordeiles minor. NIGHTHAWK.—A fairly common breeding bird of the region. When young were on the wing, by mid-July, the daily total of Nighthawks seen, occasionally reached fifteen. Two nests with fresh clutches of two eggs each were found on June 9. On June 29, a female Nighthawk was flushed by the writer from brooding her newly-hatched young in the cut-over edge of a woods flanking a cultivated field. She perched on, and parallel to, the top strand of an ordinary woven-wire fence. Previously a female had been observed by Mr. Shortt similarly perched on a slender, dead, birch twig. In this instance, the bird held its wings in a drooped position perhaps better to balance itself. An additional observation of interest pertains to a male which we observed to give its "bizzert" call from a perched position, not while on the wing which is usual.

♀ June 9, Laird
♂ June 9, Laird
Downy ♂ June 29, Maclennan
Downy ♀ June 29, Maclennan
♂ July 16, Maclennan
♀ July 25, Maclennan

Chaetura pelagica. CHIMNEY SWIFT.—Fairly common about settlements and cultivated terrain and noted occasionally in wooded areas. We were not successful in finding a nest in hollow trees where such was occasionally suspected. Chimney Swifts nest in the tower of a church in Sault Ste. Marie according to Mr. Harry Graham.

♂ June 30, Maclennan

Archilochus colubris. Ruby-throated Hummingbird.—Observed fairly regularly during the summer of 1931, three being the largest number for one day. Mr. Harry Graham has supplied us with our only breeding record for the region. His observation concerns a female in close attendance with two young near Maclennan on July 19, 1939.

Two casual notes made during the summer of 1931 are of interest. On July 13, a male Ruby-throated Hummingbird was observed following a rather restless Yellow-bellied Sapsucker. The woodpecker came to rest on a twig and the hummingbird hovered over it. When the former moved on to another perch, the hummingbird followed. The performance was repeated until they were both lost to view.

On the evening of July 15, under good light conditions from the late day's sun, a Ruby-throated Hummingbird was seen repeatedly to dart out from its perch on a telephone wire and capture minute insects on the wing, flycatcher fashion. Preece (1923) has reported a young hummingbird caught by the flower head of the common burdock, in August 1923 at Sault Ste. Marie.

♂ June 4, Laird

Megaceryle alcyon. Belted Kingfisher.—From one to three were noted almost daily during the summer and in widely separated sections. An occupied nesting tunnel was found in a gravel pit at Island Lake on June 30 in 1931 and a nest found by Mr. Harry Graham on the Root River on May 29, 1937, had five eggs in it at that time.

♀ June 26, Maclennan

Colaptes auratus. Yellow-shafter Flicker.—A common breeding bird, the most common of the woodpeckers. A set of six fresh to slightly incubated eggs was collected at Laird on June 11 in 1931. A juvenile male collected on July 25 is peculiar in respect to the extension of the black pigment areas of the body feathers, both dorsally and ventrally. The black bars on the back are fully twice as wide as is normal and the sub-terminal spots on the ventral feathers average much larger than is normal. Also, the greyish markings on the proximal portion of the ventral feathers are very dark and extensive. These features impart a general smoked and blackened effect to the specimen. A second juvenile male, though for the most part quite within the usual range of individual variation, has the front and sides of the neck rather sooty grey with a sprinkling of sooty and black streaks.

♀ June 10, Laird
Juv. ♀ June 20, Maclennan
Juv. ♂ June 20, Maclennan
♂ June 24, Maclennan
♀ June 24, Maclennan
Juv. ♂ July 2, Maclennan
♀ July 7, Maclennan
2 Juv. ♂♂ July 25, Maclennan
♂ July 25, Maclennan

Ceophloeus pileatus. PILEATED WOODPECKER.—As is characteristic of the species in most parts of its range, it was not plentiful in the Sault Ste. Marie region but one or two usually were noted daily. Several sites where these birds had excavated in standing dead trees during the late winter and early spring period were found. One was a remarkable example from the point of view of its extensiveness. An old dead maple in an open pastured woods was riddled from high up on the heavy branches down to near the base of the trunk. The workings were somewhat interrupted, trough-like gouges into the heart of the wood, parallel to the rather spiral grain of the tree. In the heavy part of the trunk these troughs were nearly a foot in depth. A heap of chips was piled at the base and scattered over a wide radius outward.

The only nesting cavity discovered was about thirty-five feet up in a Red Pine. A young of the year was collected.

♂ June 13, Laird
Juv. ♂ July 25, Maclennan

Melanerpes erythrocephalus. RED-HEADED WOODPECKER.—There is some evidence that this species may have extended its range northward to the Sault Ste. Marie region in recent times although it occurred in the Georgian Bay area in very early times. We found it rare in the summer of 1931.

♂ June 6, Laird

Sphyrapicus varius. YELLOW-BELLIED SAPSUCKER.—Next to the flicker this was the commonest species of woodpecker found in the area. Many occupied nesting holes were found during the summer and young of the year were collected.

4 nestlings (3 alcoholic) June 17, Maclennan
5 nestlings (alcoholic) June 25, Maclennan
Juv. ♀ July 3, Laird
Juv. ♂ July 25, Maclennan
Juv. ♂ July 3, Laird
Juv. ♂ July 27, Maclennan

Dryobates villosus. HAIRY WOODPECKER. — Not an uncommon species; not quite as plentiful in this area, in 1931, as the Downy Woodpecker. The earliest date on which young were observed out of the nest was July 13.

♀ June 8, Laird
Juv. ♀ June 13, Laird
♂ June 30, Maclennan
♀ July 9, Laird
Juv. ♂ July 23, Maclennan
Juv. ♂ July 27, Maclennan

Dryobates pubescens. DOWNY WOODPECKER.—Not uncommon; from one to six recorded daily throughout the summer, not including young of the year which sometimes increased daily totals to ten or twelve. The earliest date on which young were observed out of the nest was July 2.

♂ June 4, Laird
4 nestlings (alcoholic) June 17, Maclennan
♂ June 20, Maclennan
Juv. ♂ July 2, Maclennan
♂ July 2, Maclennan
2 Juv. ♀ ♀ July 3, Laird
Juv. ♂ July 7, Maclennan
2 Juv. ♀ ♀ July 9, Laird
Juv. ♂ July 9, Laird
Juv. ♂ July 10, Laird
Juv. ♂ July 15, Echo Bay
♂ July 22, Maclennan
Juv. ♀ July 23, Maclennan
Juv. ♀ July 28, Maclennan

Picoides arcticus. Arctic Three-toed Woodpecker.—Rare; found only at Point aux Pins on July 13, 1931. A scattered family group was discovered on that occasion. Starbuck (1890) noted it on Gros Cap Island in late July, 1889.

♀ July 13, Point aux Pins

Tyrannus tyrannus. Eastern Kingbird.—A common species observed regularly throughout the summer. A set of fresh eggs was collected at Maclennan on June 16. The nest was situated on the jagged top of a dead pine stub in an extensive burned-over area.

♀ June 4, Laird

Myiarchus crinitus. Crested Flycatcher.—The Sault Ste. Marie region unquestionably approximates the northern range limit of this species although Magee (1923) records a pair observed near Gargantua on Lake Superior more than sixty miles north of our area. The species is rare in the region. Mr. Harry Graham observed a parent bid feeding its young on July 16, 1939, near Maclennan.

♀ June 13, Laird

Sayornis phoebe. Eastern Phoebe.—Observed regularly but not plentifully. Our daily records show totals of eight and ten on the two days trips were made to St. Joseph Island. Bridges, culverts, and abandoned buildings there provided suitable nesting sites. Seven was the largest daily total on the mainland. Among our breeding records one concerns a nest with four eggs on June 1, 1937. This was found by Mr. Harry Graham on the beam of a house at Sault Ste. Marie. During the summer of 1931 several nests were found in mid-June which contained young.

Juv. ♀ June 15, Laird
♀ June 15, Laird
Juv. ♀ July 15, Echo Lake

Empidonax flaviventris. Yellow-bellied Flycatcher. — Observed rarely, at Desbarats, Laird and Point aux Pins.

♂ July 13, Point aux Pins

Empidonax traillii. TRAILL'S FLYCATCHER.—A fairly common species; from one to ten observed daily throughout the summer of 1931. Clumps of young poplar in burned-over areas were a favourite habitat.

♂ June 4, Laird
♂ June 19, Maclennan

Empidonax minimus. LEAST FLYCATCHER.—Recorded in numbers about equal to Traill's Flycatcher. It was found in both the alder thickets and in clumps of second-growth paper birch, at the forest edge.

♂ June 6, Laird
♂ July 4, Maclennan

Myiochanes virens. EASTERN WOOD PEWEE.—We found this species to be fairly common in the Sault Ste. Marie region in 1931. We recorded it daily from various sections of the area. As many as ten, usually males, were noted in a day. It has been recorded by Boies (1897), Magee (1922 and 1923), Fairbairn (1927) and Clarke and Ricker (1939) from this general latitude. Young of the year were observed by us, thus establishing a breeding record. In addition to old hardwood forests, the Wood Pewee occupied second growth poplar stands and paper birch copses.

♂ June 5, Laird
♀ June 7, Maclennan
♂ July 2, Maclennan
♂ July 9, Laird

Nuttallornis mesoleucus. OLIVE-SIDED FLYCATCHER.—Not plentiful but noted regularly in suitable situations, usually black spruce forests, or burned-over areas with rampikes and second growth. Two young of the year were observed with a parent bird by Mr. Shortt on July 8, thus establishing the breeding status of the species in the area.

♂ June 29, Maclennan
♂ July 13, Gros Cap

Otocoris alpestris. HORNED LARK.—The clearing of the land has undoubtedly been favourable to the Horned Lark population of this part of Ontario. The species was noted regularly by us throughout the summer of 1931. Though we recorded small numbers, certainly they were found to occur over a wide area, usually in cultivated fields. Males were still performing their nuptial flights on June 4. Young on the wing were noted by July 19.

♂ June 6, Laird
♀ June 8, Laird
♂ June 28, Maclennan
♀ July 4, Maclennan
♂ July 6, Maclennan
♂ July 20, Maclennan

Iridoprocne bicolor. TREE SWALLOW.—A common bird of the region and the most plentiful and evenly distributed species of swallow. A nest with a set of four fresh eggs was collected on June 11 from a fence post bordering a hay-field. This site was characteristic for the species in the area. By July 6, flying family groups were in evidence but a larger congregation was not recorded until July 15.

♂ June 12, Laird	Juv. ♀ July 6, Maclennan

Riparia riparia. BANK SWALLOW.—As is characteristic of this species we found it distributed according to the presence of suitable nesting situations. Our records pertain to Little Rapids, Island Lake and Gros Cap. The latter place was the locale of a very large colony of Bank Swallows; examined on July 13. A man-made cut along the highway near Gros Cap produced a sand cliff on one side approximately one hundred feet high. A total of about four hundred Bank Swallow tunnels was estimated, all situated near the top. Probably half were not in use since the number of swallows flying about was estimated at two hundred. These were mostly adults, although some young were then on the wing. One other colony is situated in the bank of the St. Mary River on the border of the Garden River Indian Reserve, according to Mr. Harry Graham.

3 Juv. ♀♀ July 13, Gros Cap	♂ July 13, Gros Cap
2 ♀♀ July 13, Gros Cap	

Hirundo erythrogaster. BARN SWALLOW. — Fairly common and generally distributed about farmland of the area. Buildings constituted the only nesting sites of the species as far as we could discover. Mr. Harry Graham of Sault Ste. Marie informs us that the species nests in the building of the Fair Grounds in the outskirts of the city of Sault Ste. Marie. Although families of young were on the wing somewhat earlier, July 15 marked the period when definite flocking of the species was first observed.

♂ June 15, Laird	Juv. ♀ July 15, Echo Bay

Petrochelidon albifrons. CLIFF SWALLOW.—A few were noted occasionally by us through the summer of 1931, near Portlock, Desbarats, Laird-Maclennan vicinity, Echo Bay, Iron River, Garden River and Sylvan Valley. The largest number on any one occasion was observed on July 20 at the last-mentioned place. The flock which was almost entirely made up of this species (4 Barn Swallows) was estimated at one hundred and fifty. Mr. Harry Graham informs us that three nests of this swallow were observed beneath the eaves of the Sault Ste. Marie Boat Club's building on June 9, 1938.

♀ June 15, Laird	Juv. ♀ July 20, Portlock
2 Juv. ♂♂ July 15, Echo Bay	

Progne subis. PURPLE MARTIN.—A familiar species about the city of Sault Ste. Marie where we observed it on several occasions in 1931. Colonies are established about business buildings along the streets and in bird houses in gardens. Mr. Harry Graham informs us that young Martins out of the nest were still being fed on August 2, 1939.

Perisoreus canadensis. CANADA JAY.—On July 17 while making an extended trip via Desbarats Lake inland to visit a locally-renowned cave in the Precambrian rock, we heard a bird voice which was thought to be a Canada Jay. Dr. C. H. D. Clarke noted the species rarely during the summer of 1935 at Pancake Bay of Batchawana Bay which is closely adjacent to the northern limits of the area with which we are concerned. The only definite summer record we have for the species in this area is that of Starbuck (1890) who reports that he observed Canada Jays in late July of 1889 on the north side of a small island off Gros Cap in Lake Superior.

Cyanocitta cristata. BLUE JAY.—Not uncommon and generally distributed. Mr. Harry Graham found a nest with four eggs about eight feet from the ground in a spruce tree near Maclennan on May 16, 1937. We secured young of the year during 1931.

Juv. ♀ July 18, Maclennan
♀ July 18, Maclennan
♂ July 18, Maclennan

Corvus brachyrhynchos. AMERICAN CROW.—Probably the most conspicuous and plentiful of the larger birds of the area. It is entirely likely that the population of this species is now much larger than before settlement and cultivation. Young crows were not noted out of the nest until the fourth week of June. A flock of sixty American Crows was seen by Professor Coventry on July 8 and on July 30 we saw a flock of approximately two hundred, the largest reported.

♂ June 12, Laird

Penthestes atricapillus. BLACK-CAPPED CHICADEE.—Fairly common and observed in many sections of the Sault Ste. Marie region. The first nest discovered, in a paper birch stub thirty inches from the ground, contained four fairly well-fledged juveniles on June 10. Young accompanied by parents were observed for the first time two days later and thereafter during the summer.

♂ June 10, Laird
♀ June 16, Maclennan
♂ June 25, Maclennan
♂ July 3, Laird
Juv. ♀ July 8, Maclennan
Juv. ♂ July 8, Maclennan

Penthestes hudsonicus. Brown-headed Chickadee.—Family groups, or individuals, were met with on five occasions during the summer of 1931. On July 8 we discovered a brood just as it had left the nest. The nest was situated five feet from the ground in a dead aspen stub within a fir-poplar forest.

2 ♂♂ July 6, Maclennan
Juv. ♀ July 8, Maclennan
Juv. ♂ July 8, Maclennan
♀ July 8, Maclennan
♀ July 20, Little Rapids
? July 20, Little Rapids

Sitta canadensis. Red-breasted Nuthatch.—An uncommon species observed on six occasions during the summer of 1931. Probably the removal of old trees and the general reduction of the forest in the Sault Ste. Marie regions has affected the numbers of this nuthatch. (Incidentally, the White-breasted Nuthatch, *S. carolinensis*, was not discovered by us and indeed may not occur in the area, but it should be looked for by future observers. Boies (1897) recorded it as "a common bird throughout the year" on Neebish Island, St. Mary's River, Michigan.)

♂ July 3, Laird

Certhia familiaris. Brown Creeper.—Not observed until July 3, on which day we were exploring an extensive woods west of Laird. In a cedar swamp we accounted for eight individuals of this species, most of which were young of the year.

Juv. ♂ July 3, Laird

Troglodytes aedon. House Wren.—A common and generally distributed breeding species. House Wrens were more plentiful about settlements, the city of Sault Ste. Marie and towns of the region, than in wilder situations, but they were also found about farms, along forest edges and in old burns as well. A nest of six slightly incubated eggs, collected near Maclennan on June 12, was situated in a stump in an alder thicket in a pastured woodlot. The cast-off skin of a Red-bellied Snake was found incorporated into the structure. It seems probable that this species has increased in the region in the past thirty-five years. (See Boies, 1897.)

The series of specimens secured demonstrates that the race represented in the area is *parkmani* and they have been so recorded by Oberholser (1934).

♂ June 9, Laird
♀ June 15, Laird
♂ July 4, Mclennan
Juv. ♀ July 6, Maclennan
2 ♂♂ July 7, Maclennan
♂ July 15, Echo Bay
♂ July 22, Maclennan

Nannus hiemalis. WINTER WREN.—Noted regularly in small numbers throughout the summer of 1931 in many parts of the area surveyed. Young of the year were collected.

♂ June 19, Maclennan	Juv. ♂ July 3, Laird
Juv. ♀ July 3, Laird	

Cistothorus stellaris. SHORT-BILLED MARSH WREN.—Four colonies of this species were discovered by us during the summer of 1931. Two were along the shore of Maskinonge Bay in the North Channel near Maclennan, one west of Laird near Pumpkin Point and a fourth at Desbarats. A "dummy" nest was found in one of the Maclennan sites but no breeding nest was discovered.

♂ June 5, Maclennan	♂ July 9, Maclennan

Dumetella carolinensis. CATBIRD.—Individuals were noted at Maclennan, Echo Bay and Iron River by our field party in 1931. The female collected, listed below, possessed the bare incubation area on the abdomen, indicating that it was probably established and breeding.

♀ July 15, Echo Bay

Toxostoma rufum. BROWN THRASHER.—Noted once during the summer of 1931, at Maclennan by Messrs. Shortt and Edmonds on June 9. The northern limits of range of this species occur in this latitude and the population of Brown Thrashers in the Sault Ste. Marie area probably varies from period to period. Furthermore the advent of the species this far north is probably of recent date. Boies (1897) does not mention it. Apparently the nearest Ontario record is that of Fairbairn (1927), who observed a pair at the Spanish River.

Turdus migratorius. AMERICAN ROBIN.—A very common breeding species throughout the region. The first young out of the nest was seen on June 6, 1931. Though irrevelant to a list of summer birds, it is of interest to record here the fact that an occasional American Robin can withstand, for a time at least, the winter of this latitude. One was observed regularly feeding on mountain ash berries in Sault Ste. Marie during the winter of 1924-25. However, on January 27, it was found dead and is now in the Museum's collection. A nest at Maclennan in a tall elm was at least 35 feet above the ground.

♂ June 11, Laird	♂ July 13, Point aux Pins
♂ June 22, Jocelyn	Juv. ♂ July 13, Maclennan
♂ June 27, Maclennan	

Hylocichla guttata. HERMIT THRUSH.—A common species in suitable forested areas throughout the region. It might be said that the Hermit Thrush constitutes one of the redeeming features of northern farming.

The farmer in the Sault Ste. Marie region endures long winters, late frosts and the rush of work in the short growing season, but in summer, at milking time and while the last of the day's chores are being done, he can listen to the vesper of the Hermit Thrush, indeed, probably several of them, as their songs intermix in their drift across his field from distant woodlots.

The writer's field record concerning certain notes uttered by the Hermit Thrush are as follows: "Heard the Hermit Thrush give its high-pitched, rather ventriloquial, whispered 'ssss,' like hissing through one's teeth; also a rather explosive 'quirt' and another note which was a rather slurred and harsh 'zwee'." The first-mentioned is like, or similar to, a note uttered by the American Robin, the Olive-backed Thrush and Wilson's Thrush, and would appear to be a kind of warning or quiet alarm, as judged from circumstances under which I have heard it.

A nest found on June 4 contained four fresh eggs. Another, found on July 24, contained three heavily incubated eggs. Probably the late clutch represented a second nesting consequent to an unsuccessful previous one, but two successful nestings of the species in this latitude may be possible.

Juvenile specimens collected were found to have a number of small red mites clustered about the anus.

(We did not discover the Wood Thrush, *Hylocichla mustalina*, in this area although it has been recorded for this latitude; see Clarke and Ricker, 1939; Van Tyne, 1938; and Boies, 1897.)

♀ June 4, Laird
♂ June 4, Laird
♂ July 15, Maclennan
♀ July 24, Laird
Juv. ? July 27, Maclennan
Juv. ♂ July 27, Maclennan

Hylocichla ustulata. OLIVE-BACKED THRUSH.—A generally distributed species in suitable forested areas but not as plentiful as the Hermit Thrush.

♂ July 2, Maclennan
♂ July 8, Maclennan

Hylocichla fuscescens. WILSON'S THRUSH.—Found to be fairly common throughout the Sault Ste. Marie region; about as numerous as the Olive-backed Thrush but not as plentiful as the Hermit according to our daily records. Flying young, two distinct broods, were observed on July 9 near the shore of Lake George.

The three specimens collected in this area are of interest in connection with the racial identity of the Wilson's Thrush population occupying the southern portion of central Ontario and the northern portion of southern Ontario. For several years material has been accumulating in the

R.O.M.Z. which tends to explain a statement of range in the 1931 edition of the A.O.U. Check-List. It is stated therein that *H. f. salicicola*, the Willow Thrush, occurs from southern British Columbia, etc., to southern Manitoba, etc. "(and apparently also Newfoundland)." The writer has reported (Snyder, 1938) that *salicicola* extends into extreme western Ontario. Furthermore, it seems evident from available material that the form *salicicola* extends eastward from the prairie provinces to Lake Superior in the vicinity of Thunder Bay. The range is here interrupted. The northern hump of Lake Superior virtually bisects the northern periphery of range of the species although scattered and very rare occurrences on the north shore may tend to suggest continuity. On the eastern end of Lake Superior, Wilson's Thrush is again to be found and thence southeastward to southern Quebec, etc. In this region the racial problem is somewhat confused. For example, one of the specimens from Sault Ste. Marie, a male, is typical of *H. f. salicicola*, while its known mate (determined in the field) can be referred to *H. f. fuscescens* (assuming that specimens from extreme southern Ontario with which it was compared are of the typical race). Many of the specimens examined from the Sault Ste. Marie latitude in Ontario are referable to *salicicola*. Quebec specimens and material from farther east, which would connect the Ontario region with Newfoundland, have not been seen but it appears possible that the two forms of this species are, or have been, more nearly distributed as northern and southern, rather than eastern and western, races. The confusion observed in specimens from south-central Ontario and from northern portions of southern Ontario may have arisen by a northward movement of the more southern form *fuscescens*, into the range of *salicicola*. It is well known that species have extended their range northward in this area. It is suggested that racial populations might do the same thing, eventually to break the genetical uniformity of the forms concerned. The subject of racial identity of Wilson's Thrush in this region has been discussed by Aldrich (1939).

♀ June 24, Maclennan	♀ June 5, Laird
♂ June 24, Maclennan	

Sialia sialis. RED-BREASTED BLUEBIRD.—A fairly common and generally distributed breeding bird of the region, a status probably favoured by deforestation, and pioneer farming. A nest with four incubated eggs was found as late as July 22 in 1931.

♂ June 16, Laird

Regulus satrapa. GOLDEN-CROWNED KINGLET.—Rather uncommon for the region as a whole but more numerous in certain areas. Nine were observed on a single day (July 13) in the pine barren and its borders at Point aux Pins. Young of the year were observed by Mr. Baillie on July 18, thus establishing a breeding record for the area. (Future observers in the region should look for the Ruby-crowned Kinglet, *Corthylio calendula*, which though not discovered by us may occur as a rare inhabitant of certain black spruce bogs. It is reported for Sugar Island, Michigan (Van Tyne, 1838).)

♂ June 4, Laird ♂ July 6, Maclennan

Bombycilla cedrorum. CEDAR WAXWING.—A common and generally distributed breeding species. Incubation of a set of five eggs found at Iron River on July 15 was well advanced.

♀ June 5, Laird ♂ July 13, Gros Cap
♂ July 8, Maclennan

Lanius ludovicianus. COMMON SHRIKE.—An uncommon breeding bird of cultivated areas. Noted by us at Garden River, Bar River, Echo Bay and Maclennan.

Juv. ♀ June 29, Maclennan ♀ July 8, Maclennan
♂ July 6, Maclennan

Sturnus vulgaris. COMMON STARLING.—A fairly common bird of settled sections in 1931 although not known to occur in the area prior to 1927. The first young of the year were noted by us on June 14. Flocks were seen after the third week of June with increasing regularity. Fifty was the largest total record on any one day. The earliest occurrence of the Starling in the region is based on a specimen now in the R.O.M.Z. picked up dead in Thessalon on February 10, 1927 (Baillie, 1928).

♂ July 3, Laird

Vireo solitarius. SOLITARY VIREO.—Noted once each in three sections of the area, near Laird, Iron River and Point aux Pins.

♂ June 6, Laird

Vireo olivaceus. RED-EYED VIREO.—A very common breeding bird of the area.

♂ June 10, Laird Juv. ♀ July 27, Maclennan

Vireo philadelphicus. PHILADELPHIA VIREO.—Identified once, on June 9, near Maclennan and not again met with during the summer of 1931. Undoubtedly the area is on the southern fringe of the range of this species in Ontario.

Mniotilta varia. BLACK AND WHITE WARBLER.—A fairly common warbler throughout the region. The first nest discovered during the summer of 1931 was situated in a cavity of a fire-charred pine stub, 28 inches from the ground. The nesting entrance was a Pileated Woodpecker drilling made to gain access to a carpenter ant colony at the heart. The ants had made a vertical channel about four inches in diameter and their "saw-dust" had provided a floor at this point. Incidentally the female of this nesting pair performed the "broken-wing ruse" when her nest was discovered. The nest contained four fresh eggs on June 7. A second nest containing four young on June 23 was also situated in a tree cavity. This site was a rotten stump and the entrance to the nesting chamber was 8 inches from the ground.

♂ June 10, Laird   3 juv. ♂♂ June 23, Maclennan
Juv. ♀ June 23, Maclennan   Juv. ♀ July 24, Maclennan

Vermivora peregrina. TENNESSEE WARBLER.—A rare species identified on two occasions (June 2 and 13, Laird and Maclennan respectively) during the summer of 1931.

Vermivora ruficapilla. NASHVILLE WARBLER.—A fairly common breeding species well distributed throughout the area. As many as twenty individuals, usually singing males, were recorded on several days. Juveniles with parents were observed and collected.

♂ June 15, Laird   Juv. ♀ July 15, Echo Bay
Juv. ♂ July 7, Maclennan

Compsothlypis americana. PARULA WARBLER.—Rare; the male specimen collected on June 9 seemed to be established in a habitat suitable to the species and repeatedly sang "zeeeeee-ta," the quality dry and insect-like, the first portion ascending somewhat in pitch and the final syllable dropped and abrupt.

♂ June 9, Laird

Dendroica aestiva. YELLOW WARBLER.—Rather uncommon; our daily records for the summer of 1931 tabulate one or two, occasionally three, on approximately one-third of the days in the field. Our only breeding record is that of Mr. Harry Graham—a nest found near Sault Ste. Marie on June 30, 1939.

♂ June 5, Laird   ♂ June 25, Maclennan

Dendroica magnolia. MAGNOLIA WARBLER.—Not uncommon; found most plentifully in the older, dry forests with a predominance of evergreens.

♂ June 4, Laird   ♂ July 13, Point aux Pins

Dendroica coronata. MYRTLE WARBLER.—Rather local in distribution usually favouring pine stands, consequently rather uncommon from the region as a whole. Found most plentifully on Long Point near Maclennan and at Point aux Pins. Parents were observed carrying food to their young, thus establishing the local breeding status of the species.

♂ June 10, Laird
♀ July 6, Maclennan
Juv. ♀ July 27, Maclennan

Dendroica virens. BLACK-THROATED GREEN WARBLER.—A common and well distributed species. Twenty-four were noted on July 9. The immature specimen listed below had almost completely lost its juvenile body plumage and acquired its first winter plumage, but in all probability it had been reared locally. Young still being fed by parents were observed near Maclennan as late as August 11 in 1938 by Mr. Harry Graham.

♂ June 10, Laird
Imm. ♂ July 28, Maclennan

Dendroica fusca. BLACKBURNIAN WARBLER.—A fairly common species observed regularly throughout the summer. A nest was found on June 15 by Mr. Shortt in a balsam fir, near the main stem and top, approximately 35 feet from the ground. It contained two Cowbird's eggs only.

♂ June 9, Laird
♀ June 15, Laird
♀ June 22, Jocelyn Twp., St. Joseph Is.
♂ July 4, Maclennan

Dendroica pensylvanica. CHESTNUT-SIDED WARBLER.—A common and generally distributed breeding species. Mr. Harry Graham found a nest containing a Cowbird's egg in a hazel shrub on June 25, 1939. We observed juveniles in July, 1931.

♂ June 11, Laird
♂ July 7, Maclennan
Juv. ♀ July 13, Gros Cap

Dendroica castanea. BAY-BREASTED WARBLER.—A rare warbler in the region. A pair was observed in a black spruce stand near Maclennan on July 8 and one was noted at Point aux Pins on July 13.

Seiurus aurocapillus. OVEN-BIRD.—A common species. Although found in all but the wetter forested areas, it was most plentiful in poplar-fir and old hardwood stands. One nest examined was within a bare, open space in a poplar-fir forest. The appearance of the immediate site was as if the matted leaves on the forest floor had been cleft along a line, lifted and propped up, thus providing a cave in which the nest was built.

♂ June 4, Laird
Juv. ♂ July 2, Maclennan
♂ July 2, Maclennan
Juv. ♂ July 3, Laird
♀ July 18, Maclennan
Imm ? July 22, Maclennan

Seiurus noveboracensis. NORTHERN WATER-THRUSH.—Our daily records include one individual of this species noted on July 2 and one on July 21. Both observations were made on the shore of the St. Joseph Channel. The great rarity of the Water-Thrush in the area is apparently due to the absence of suitable habitat.

Oporornis philadelphia. MOURNING WARBLER.—A common and well distributed warbler in the Sault Ste. Marie region. Young just out of the nest were noted and one collected.

♂ June 5, Laird
♂ June 8, Laird
♂ July 6, Maclennan
Juv. ♂ July 6, Maclennan
♀ July 24, Echo Bay

Geothlypis trichas. MARYLAND YELLOW-THROAT.—Found sparingly here and there where suitable habitats existed. Small marshes found along the shore of the St. Joseph Channel and wet grass flats and alder swales along the St. Mary, Iron, and Echo Rivers, etc., were occupied by the species. Ten were observed on July 9. A nest containing four fresh eggs was found on June 29.

♀ June 5, Laird
♂ June 5, Laird
♂ June 13, Laird
♀ June 29, Maclennan
2 ♂♂ July 9, Laird
♂ July 15, Echo Bay
Juv. ♂ July 16, Desbarats
Juv. ♀ July 27, Maclennan

Wilsonia canadensis. CANADA WARBLER.—Not uncommon; observed regularly but not in large numbers.

♂ June 4, Laird
♂ June 12, Laird

Setophaga ruticilla. AMERCIAN REDSTART.—A very common warbler of the region, perhaps the most plentiful representative of the Family. Its numbers and regular distribution in the area was approached only by the Ovenbird, Chestnut-sided, Mourning and the Black-throated Green Warblers, in the order named. Six nests with eggs were found during the first two weeks of June. One had been parasitized by the Cowbird; another contained a clutch of five eggs which is somewhat unusual. Four out of the six nests were situated in alder shrubs from four to eight feet from the ground. Concerning the others, one was built in choke cherry and the other in mountain maple.

♀ June 5, Laird
♂ June 6, Laird
Juv. ? July 18, Gros Cap
♀ July 18, Maclennan

Passer domesticus. ENGLISH SPARROW.—Observed daily during the summer of 1931 and found to be established about settlements and many of the farmsteads. Nests which already contained young were found by June 2. Buildings constituted the usual sites for nesting but occasionally they were found elsewhere. One nest was located in the hollow top of a fence post, the peculiarity of the site being that the post had broken off at the ground and was supported in a low position by the slack strands of the wire fence. The entrance hole and nest were a mere few inches from the ground and circumstances suggested that the post had been in this position at the time the situation was chosen by the sparrows.

One juvenile specimen secured is of interest. The basal portion of the primaries and secondaries are whitish on both webs. Normally the shaft and terminal portion of these feathers are grey-brown with a restricted whitish margin on the basal portion of the inner web. Further, the grey-brown terminal half of the primaries and secondaries of the peculiar specimen in question present a narrowly barred appearance. Examination under 12× magnification shows that the barring is an effect produced by an irregularity of the barbules along a transverse line. They are depressed against the barbs and to some extent lack pigmentation. Furthermore, where the bar pattern crosses the shaft, there is a slight buckling of the shaft, or a perceptible weakening of its structure. Another abnormality concerns the upper wing coverts which are very short and under-developed compared to normal specimens of about the same age. These feathers also show a barred effect. Normally these coverts would be sufficiently long to extend over the basal white portion of the flight feathers. The white area on the wing of the abnormal specimen is consequently particularly conspicuous due to exposure. One additional feature which appears to be abnormal is that the egg-tooth, or a considerable portion of it, is still present on this specimen although the bird was approximately two weeks old. Although comments on this specimen can be little more than descriptive, it may be stated that the under-developed wing-coverts, the five or six transverse bars on the flight feathers which seem to constitute lines of weakness in the feather structure, and the reduced pigmentation in the basal half of the flight feathers are an interesting combination of expressions of deficiencies.

♂ June 18, Maclennan Juv. ♂ June 19, Maclennan

Dolichonyx oryzivorus. BOBOLINK.—Noted regularly throughout the summer, though not plentifully. Finding the species in meadows on St. Joseph Island, at Maclennan, Garden River, Iron River, Sault Ste. Marie and Point aux Pins demonstrates the general establishment of the species in the area which lies close to the northern limits of range in the province. Young just out of the nest, found in a hay meadow near our camp at Maclennan, were collected. A male taken July 18 had already commenced to assume its winter plumage.

We were not successful in determining when this species spread into the Sault Ste. Marie region but no doubt it was at an early date. Boies (1897) recorded it for a neighbouring area in Michigan in 1893.

♂ June 6, Laird
♂ June 16, Maclennan
♂ July 6, Maclennan
Juv. ♀ July 18, Maclennan
♀ July 18, Maclennan
2 Juv. ♂♂ July 18, Maclennan
♂ July 18, Maclennan
Juv. ♀ July 28, Maclennan

Sturnella magna. Eastern Meadowlark.—Boies (1897) reported that the Meadowlark bred sparingly on Neebish Island (Michigan) in the period 1892-94. Mr. L. G. Davidson, a farmer, near Maclennan, told us that he found the Eastern Meadowlark established in the area in 1900 and it could well have been there previous to that date. We found pairs or singing males here and there throughout farmland of the region but the species was not particularly plentiful. Although breeding was not definitely established, pairs were noted in certain meadows throughout the summer and they were surely not there for any other purpose. Subsequently Mr. Harry Graham found a nest with four eggs at Sault Ste. Marie on July 1, 1937.

♀ June 12, Laird
♂ June 12, Laird
♂ June 22, Jocelyn Twp., St. Joseph Is.
♀ July 8, Maclennan

Sturnella neglecta. Western Meadowlark.—Mr. L. G. Davidson, a farmer, near Maclennan, knew this species well, having lived in the Canadian West where it was a plentiful and familiar bird. He recalled that he first noticed its characteristic song in the Sault Ste. Marie region about 1921 or 1922, a date which may well mark its advent into the area. The upper peninsula of Michigan would seem to present a highway for the eastern extension of range of western forms. The Western Meadowlark has not increased markedly and is decidedly less common than the eastern species. One or two were noted at each of the following situations during June and July—near Sault Ste. Marie, Bar River, Garden River, and Maclennan.

♂ June 22, Maclennan

Agelaius phoeniceus. Red-winged Blackbird.—A marsh on the edge of Maskinonge Bay near our camp supported a colony of ten or fifteen pairs of redwings, and the species was found established in marshes in a dozen sites scattered along the shores of rivers and lakes throughout the region. Nests in the colony near camp contained young on June 5 but others contained eggs as late as June 16.

The average measurements of four adult males collected near camp are as follows,—Length 224, wing 122, tail 92.7, length of culmen 21.7, depth of bill at base 10.8, weight (of two) 65.5. A fifth male from the same colony measures L. 238, W. 126, T. 99, Cul. 26, depth at base 12.5, Wt. 71. This latter specimen is extremely large and well within the limits of size ascribed to the form, *A. p. arctolegus*. The other males conform to the dimensions of the typical race. This would serve to illustrate that an individual specimen cannot be positively ascribed to a size-race, particular in the case of Red-wings where racial sieving is apprently in an incipient stage (see Taverner, 1939).

♂ June 5, Maclennan
♀ June 16, Maclennan
2 ♂♂ June 16, Maclennan
Juv. ♀ June 20, Maclennan
2 ♂♂ June 20, Maclennan
Juv. ♀ June 20, Maclennan

Quiscalus quiscula. CROW BLACKBIRD.—Noted commonly and regularly during most of June, but from June 24 their numbers became fewer and observations were more intermittent. During the second week of July they were rarely observed. No pronounced flocks were seen until July 27. These observations indicate the evacuation of nesting areas rather completely soon after the young are on the wing. If the species does not actually start its migration in early July and leave the area, we failed to discover their concentration points during this period.

A nest found on a beam of an open shed in farmland contained three small nestlings on June 2.

♀ June 13, Laird
Juv. ♀ June 15, Laird

Molothrus ater. COWBIRD.—Common and conspicuous through the month of June; observed more irregularly after July 5, pronouncedly so after July 9. No new or rare instances of parasitism were discovered but among the usual hosts we have already mentioned the Blackburnian Warbler, Chestnut-sided Warbler and Redstart. The species has doubtless increased with the clearing of the land.

♂ June 6, Laird
Juv. ♀ July 2, Maclennan
♀ July 8, Maclennan
♂ July 15, Echo Bay

Piranga erythromelas. SCARLET TANAGER.—Rather uncommon but one or two were noted about one-third of the days afield during the summer of 1931.

♂ June 6, Laird
♂ July 9, Laird

Hedymeles ludovicianus. ROSE-BREASTED GROSBEAK.—An uncommon breeding bird of the region. We recorded pairs or families on five occasions in four distinct sections of the region during the summer of 1931. A nest containing four slightly fledged young was found in a maple forest, a favoured habitat, in a fork of the thin terminal branches of a sugar maple, fifteen feet from the ground.

♀ June 22, Jocelyn Twp., St. Joseph Is.
♂ June 22, Jocelyn Twp., St. Joseph Is.
♀ June 29, Maclennan
4 nestlings (3 alcoholic) June 29, Gordon Lake
♂ July 24, Echo Bay
Juv. ♂ July 24, Echo Bay

Passerina cyanea. INDIGO BUNTING.—Observed fairly regularly and not uncommonly throughout the summer and found breeding. Brushy pastures and the edges of forests and in burns were favoured habitats of the species.

♂ June 6, Laird
♂ June 11, Laird
2 ♂♂ July 2, Maclennan
♀ July 2, Maclennan
♂ July 18, Maclennan
♂ July 23, Maclennan
Juv. ? July 27, Maclennan
Juv. ♂ July 27, Maclennan

Hesperiphona vespertina. EVENING GROSBEAK.—On July 23 two of these birds flew over us on the road at Laird, coming from the old, heavy forest in that area. They were collected and proved to be a pair. The testes of the male were beginning to atrophy, being yellowish in colour and 7 mm. in length. The female showed signs of breeding, the belly being bare and calloused.

The exact site where these birds were collected is approximately fourteen miles from Sault Ste. Marie, Michigan, as the grosbeak flies. The latter place-name is the type locality of the form but the type was winter-taken, indeed the species was not known to breed in the east until comparatively recent years. Additional records of the species for the Sault Ste. Marie region, Ontario, have come to hand from Mr. M. J. Magee. He observed four adults and three young on August 1, 1935, and had previously recorded the observation of a male at Goulais Bay on August 4, 1922 (Magee, 1923).

♀ July 23, Laird
♂ July 23, Laird

Carpodacus purpureus. COMMON PURPLE FINCH.—A fairly common and generally distributed breeding bird of the region.

♂ June 4, Laird
♂ June 22, Jocelyn Twp., St. Joseph Is.
♂ June 26, Maclennan
♀ July 15, Echo Bay
♀ July 24, Echo Bay
♂ July 24, Echo Bay
Juv. ♂ July 27, Maclennan

Spinus pinus. PINE SISKIN.—Rather scarce; met with on only four occasions during the summer of 1931. A young of the year was collected in midsummer.

Juv. ♂ July 9, Laird

Spinus tristis. AMERICAN GOLDFINCH.—A very common species noted daily throughout the summer. Three nests, all in the course of construction, were all found on the same day, July 15, in three distinct localities.

♀ July 4, Laird
♂ July 18, Maclennan

Loxia leucoptera. WHITE-WINGED CROSSBILL.—Individual birds were observed twice during the summer of 1931, one on July 20 at Little Rapids and one on July 22 at Echo Bay.

Pipilo erythrophthalmus. EASTERN TOWHEE.—An uncommon species which was observed on eight occasions during the summer of 1931 in widely separate areas—Gros Cap, Echo Bay, Bar River, and Maclennan. Brushy hillsides usually where mixed and hardwood forests had been recently removed were the usual habitats.

July 8, Maclennan
♂ July 15, Echo Bay
♂ July 18, Maclennan

Passerculus sandwichensis. SAVANNAH SPARROW.—A very common breeding bird of the region, one which no doubt is much more numerous now than it was before the land was cleared. One day's total, July 8, was sixty-five. A nest found on June 2 contained three fresh eggs and a clutch of four found on June 12 was also fresh.

The series of skins collected conforms to the description of *P. s. mediogriseus* of Aldrich (1940). The graded variation of eastern Savannah Sparrows as disclosed by Aldrich and the findings of others making similar studies, point to an ultimate consideration of the clines of Huxley (1939) in taxonomy.

2 ♂♂ June 5, Laird
♀ June 12, Laird
♂ June 16, Maclennan
♂ June 16, Laird
4 ♂♂ June 25, Maclennan
Juv. ♀ July 12, Maclennan
♀ July 20, Little Rapids

Pooecetes gramineus. VESPER SPARROW.—A common breeding species found throughout the area where fields and dry open pastures afforded suitable habitat. Although well incubated eggs were found as early as June 6, in 1931, fresh eggs were found late in the same month. One clutch which is remarkable because it consists of six eggs, was slightly incubated on July 5. This latter set is very uniform in colour and pattern. An egg in the oviduct of a female collected on July 22 is our latest nesting evidence.

2 ♂♂ June 4, Laird
♀ June 6, Laird
♂ June 11, Laird
♀ June 16, Maclennan
3 ♂♂ June 22, Jocelyn Twp., St. Joseph Is.
♀ June 23, Maclennan
♂ July 4, Maclennan
♀ July 22, Maclennan
Juv. ♀ July 25, Maclennan
♂ July 25, Maclennan

Junco hyemalis. SLATE-COLOURED JUNCO.—Fairly common and observed regularly throughout the area. Although young out of the nest were noted as early as June 9, fresh eggs were collected on July 4.

♂ June 5, Laird
Juv. ♂ July 9, Laird
♂ June 12, Laird
♂ July 6, Maclennan
Juv. ♂ July 13, Gros Cap
Juv. ♀ July 13, Point aux Pins

Spizella passerina. CHIPPING SPARROW.—A very common breeding species. The song of the Chipping Sparrow is known to be variable, i.e. its quality may be musical or "wooden," but perhaps it has not been emphasized that it can actually overlap the quality and pattern of the the song of the Clay-coloured Sparrow. The song of a male heard and collected on July 15 was dull, insect-like in quality and broken into two phrases, the second about a musical third higher than the first. In other words it was very like one song of the Clay-coloured Sparrow.

A newly completed nest without eggs was found on June 5; two nests each with four fresh eggs were found on June 7. The first young out of the nest were noted on June 20. Nests with fresh eggs were found as late as July 2.

♂ June 6, Laird
♂ June 19, Maclennan
Juv. ♂ June 20, Maclennan
♀ June 25, Maclennan
2 juv. ♀ ♀ July 6, Maclennan
♂ July 8, Maclennan
2 ♂ ♂ July 15, Echo Bay
Juv ♀ July 20, Little Rapids
♂ July 22, Maclennan

Spizella pallida. CLAY-COLOURED SPARROW.—On June 26 an individual of this species was seen and heard near Laird. It was discovered in a clump of small balsam poplars in an open scrubby pasture and although collected, the specimen was not recovered, one of those disappointing events all too common to the collector. However, on July 20, a breeding colony of this species was found at Crates Dam near Little Rapids. A total of fifteen individuals was tabulated including adults and young out of the nest. The situation was a hot, sandy slope, an old pine barren from which most of the trees had been removed. There was the occasional seedling or old white pine, with here and there clumps of young aspen poplar. The area was largely overgrown with Saskatoon berry, sweet fern, bush honeysuckle, blueberries and bracken fern. This is the first known breeding colony in Ontario east of the Port Arthur district and suggests again the probable extension of western forms into the Sault Ste. Marie region by way of the upper Michigan peninsula.

Juv. ? July 20, Little Rapids
Juv. ♀ July 20, Little Rapids
3 ♂ ♂ July 20, Little Rapids

Zonotrichia albicollis. WHITE-THROATED SPARROW.—A very common species. A number of nests with eggs were found during the summer of 1931. Young out of the nest were first noted on June 23.

♂ June 10, Laird
♀ June 11, Laird
♂ June 11, Laird
3 nestlings (alcoholic) June 12, Laird
Juv. ♂ July 4, Maclennan
2 ♀♀ July 8, Maclennan
♀ July 18, Point aux Pins
Juv. ♀ July 17, Desbarats
♂ July 22, Maclennan
Juv. ♂ July 25, Maclennan

Melospiza georgiana. SWAMP SPARROW.—Not uncommon for the region as a whole though restricted to suitable sites along the borders of marshes, lakes and streams. A nest with three fresh eggs was collected on June 11, 1931.

♀ June 13, Laird
♀ July 6, Maclennan
Juv. ♂ July 15, Maclennan

Melospiza melodia. SONG SPARROW.—A very common breeding species throughout the region. Young out of the nest were observed as early as June 6, although the majority of Song Sparrows did not nest so early. A set of five well-incubated eggs collected on June 11 would seem to represent an average date for this latitude. A nest observed on July 8 contained four incubated eggs.

A recent study of the races of Song Sparrows in Ontario (Fleming and Snyder, 1938) shows that the Sault Ste. Marie region, though not mentioned specifically, constitutes a hub where the local population can be influenced by three races. To the west and north (the upper peninsula of Michigan and over the top of Lake Superior) *M. m. juddi* ranges; to the south and southeast (Michigan and Bruce County, Ontario) *M. m. euphonia* has been recognized; and to the east and northeast, *M. m. melodia* is found. The Sault Ste. Marie specimens cannot be referred definitely to any of these forms.

♀ June 4, Laird
Juv. ♂ June 6, Laird
♀ June 11, Laird
♂ June 11, Laird
♀ June 19, Maclennan
4 ♂♂ June 19, Maclennan
♀ July 4, Maclennan
♂ July 6, Maclennan
♂ July 22, Maclennan
Juv. ♂ July 24, Maclennan

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REPTILES AND AMPHIBIANS OF THE SAULT STE. MARIE REGION, ONTARIO

By E. B. S. LOGIER

FOREWORD

The list of reptiles and amphibians presented in this paper is doubtless incomplete, and further work in the region would very probably reveal the presence of additional species. Several species of snakes that we did not find in 1931 have since been reported to us on good authority.

Measurements are all from preserved material. The tail length of salamanders was measured from the posterior margin of the vent. Frogs were laid on their backs and the body straightened by pressure on the throat and pelvic regions, the combined length of the head and body (referred to as head-body length) was measured with dividers from the tip of the snout to the posterior surface of the ischial symphysis. The head length was measured with dividers from the tip of the snout to the posterior margin of the tympanic ring. The hind-leg-to-heel length was obtained by pinning the specimen down and pinning the leg out straight at a right angle to the body, with the foot sharply flexed at the heel; the length was taken from the ischial symphysis to the convexity of the heel. The foot length, when stated, is that of the whole foot including the tarsal and metatarsal bones, measured from the convexity of the heel to the tip of the fourth toe.

Measurements of snakes are only approximate, for while they were pinned down, starting at the head, and straightened as much as possible, there is bound to be some distortion of length. When noting the scutellation of the head in snakes, numbers joined by a plus sign refer to scales on the same side of the head, as, temporals 1+2, indicating one scale in the first row and two in the second on the same side. The length and width of turtle shells were measured in a straight line through the greatest dimensions, not over the curvature of the carapace.

The treatment of the leopard frogs and wood frogs is provisional. Referring of the leopard frogs to *Rana pipiens*, and the wood frogs to *Rana sylvatica* without subspecific distinction, may draw criticism, but these two groups are in a state of confusion. The characters given by Cope (1889, 403-406) for *Rana brachycephala*, and those summarized by Kauffeld (1937, 84-87) as being distinctive of *R. pipiens* or *R. brachycephala* are not satisfactory when applied to Ontario material. The wood frogs are in an equally dubious state, with Ontario material again mixing up characters assigned by various authors to *R. sylvatica* or *R. cantabrigensis*.

Until satisfactory characters have been established for each of these forms and associated with geographical ranges, we see no good reason for any other procedure than that provisionally adopted here.

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REPTILES

Opheodrys vernalis vernalis (Harlan). SMOOTH GREEN SNAKE.—We did not find this snake in the area covered although we expected to do so. Mr. Burns writes us that it "is quite in the southerly part of Algoma District, including St. Joseph Island. We have noted quite a few specimens about 15" to 18" in length, around our camp on the north end of St. Joseph Island, near Desbarats, and have also observed specimens here in Sault Ste. Marie, and at other points in the southerly part of the Mississauga region."

Lampropeltis triangulum triangulum (Lacepede). MILK SNAKE.—We are indebted to Mr. Burns for a report of this species. He writes: "In July 1937 I saw a milk snake in the Township of Mack on a portage between Lake Magog, (Granary Lake), and Lake of the Mountains, (Lake Dubourne), approximately seven miles N.E. of the town of Blind River. The specimen was about three feet long, being light gray with the customary dark spots. It slowly crossed the portage in front of me when I almost accidentally stepped on it. I was quite surprised to see it as it was really the first milk snake that I definitely recalled seeing in this part of northern Ontario up to that time."

Natrix sipedon sipedon (Linne). NORTHERN WATER SNAKE.—We are again indebted to Mr. Burns for our only information about this snake in Algoma District. He writes: "From time to time we have noted odd specimens of common water snakes between Batchawana Bay, Lake Superior, about 30 miles north of here, and eastward along the St. Mary River to the North Channel of Lake Huron. The specimens that we see as a general rule are not much more than 24" to 30" in length. They are not nearly so common as the garter snakes and I personally never saw nor heard of one up here as large as specimens that I have noted at the eastern end of Lake Ontario in Frontenac County . . . ."

Storeria occipitomaculata (Storer). Red-bellied Snake.—This, according to our observations, was the commonest snake in the area worked by our party. It was taken in the vicinity of Maclennan, Laird and at Lake George. Mr. Burns reports it from St. Joseph Island, from where he sent us a specimen (and from near Lake Achigan at mile 45 on the Algoma Central Railway, where Mrs. Burns had seen many). We collected twenty-seven specimens ranging in length from 133.5 to 286 millimeters. The scutellation was mostly: preoculars 2; postoculars 2; temporals 1+2; upper labials 6; lower labials 7; dorsal rows 15; ventrals, males 117-123½, females 121-129; subcaudals, males 45-51, females 37-44. In two specimens the lower preocular of one side was fused with the postnasal. Upper labials were occasionally 5 or 7 on one side; one specimen has 7 on both sides. Lower labials are occasionally 6 on one side, and in two cases there are 5 and in another 8 on one side (the latter number resulting from the division of the 3rd scale). Five specimens have two extra short scale rows on the neck, bringing the anterior count to 17. Two specimens had a small scale in the loreal region on one side.

The dorsal colour of these snakes varied from pale grayish brown through rich reddish brown or dark slate to almost black; the belly from strong brick-red to very pale rose pink. The anterior ventrals were gray in a few specimens.

Thamnophis sirtalis sirtalis (Linne). Eastern Garter Snake.—This, next to the red-bellied snake, was the snake most often seen. It was taken in the vicity of Maclennan, Laird, Lake George, Gordon Lake and at Gros Cap. It was reported by Williamson (1907, 137) from Searchmont. There are twenty specimens in our collection, of which six are males. They range in length from 281 to 786 millimeters. The scutellation was mostly as follows: preoculars 1; postoculars 3; upper labials 7; lower labials 10; temporals 1+2, but often irrgular; dorsal rows 19-17; ventrals, males 149-158, females 148-151; subcaudals, males 67-79, females 61-74. Some irregularities in scutellation occur: 4 postoculars occur on one side in one specimen. One specimen has 8 upper labials on one side. Three have 9 lower labials on one side, and one has 9 on both sides; 8 occur once on one side. There are 21 scale rows on the neck region in five specimens, extending back as far as the 8th, 10th and 11th ventrals; 20 occur in two, extending back to the 8th ventral.

The colour and striping of these snakes was normal, showing about the usual extent of variation with black or brown ground colour and the striping bright or dull yellow, or brownish, and occasionally with red anteriorly on sides. One specimen was nearly black with the striping obscure, the belly dark gray and the chin white.

Clemmys insculpta (Le Conte). WOOD TURTLE.—There is a record of the wood turtle from Searchmont, northeast of Sault Ste. Marie (Williamson 1907, 138). This, and its occurrence in the northern peninsula of Michigan where it was reported from Schoolcraft County by Ruthven, Thompson and Gaige (1928, 146, 149), make it seem probable that additional records may yet be expected from the Sault Ste. Marie region.

Chrysemys bellii marginata Agassiz. WESTERN PAINTED TURTLE.—The painted turtle was found occasionally. We have two from St. Joseph Channel near Maclennan and one from the vicinity of Echo Lake. There is also in our collection a single egg found by His Honour Judge E. Lovering of Toronto at Copp Lake on July 11, 1940, lying in the water at the shore, and brought by him to the museum.

The Echo Lake specimen had a very large plastral dark blotch approaching that of *C. b. bellii* in character; the greatest width of the blotch was .673 of the width of the plastron, and that at the center was .495. The carapace of this specimen measured 170×133 millimeters, which is larger than average for *C. b. marginata*. The St. Joseph Channel specimens were normal *marginata*. The carapace measurements of these were 156×114 and 151×110 millimeters; the figures for the width of the plastral dark blotches of these are, respectively: greatest width .450 and .500, width at center .274 and .338 of the width of the plastron. The dorsal markings in all cases were those of *marginata* and the neck and limbs were marked with red.

Since *C. b. bellii* occurs throughout the northern peninsula of Michigan (Ruthven, Thompson and Gaige 1928, 159, 160), and at Lake Nipigon, Thunder Bay District, Ontario, intergrades might be expected in territory eastward from Lake Superior.

AMPHIBIANS

Necturus maculosus maculosus (Rafinesque). MUDPUPPY.—This salamander was recorded by Agassiz (1850, 382) from Sault Ste. Marie. Its occurrence in both northern and southern Michigan and at Isle Royal (Ruthven, Thompson and Gaige, 1928, 13, 15) suggest that the lack of southern Algoma records since 1850 are the result of neglect rather than of geographical distribution.

Triturus viridescens viridescens (Rafinesque). NEWT.—The newt was found sparingly in the vicinity of Maclennan. Only nine specimens were taken (four males, five females); seven were found in the weedy edge waters of St. Joseph Channel, the other two were collected in a swale in a grain field near Maclennan. The following measurements were obtained: males, average total length 98.3 millimeters with extremes of 85 and 104.8; average tail length .490, extremes .450 and .512 of the total length. Females, average total length 80.7 with extremes of 65.5 and 102 millimeters; average tail length .488, extremes .473 and .511 of the total length. The tail crests of the males were well developed, giving an average total depth to the tail of .118 of the total length of the animal with extremes of .110 and .130. The horny ridges and toe tips were pronounced. The specimens were collected in June.

Ambystoma jeffersonianum (Green). JEFFERSON'S SALAMANDER.—Metamorphosing specimens of this species of from 42 to 47.5 millimeters and advanced larvae were collected on July 6 from a partly shaded pond in a wood lot near Maclennan; also younger larvae from 19 millimeters up, and presumably the same species. *Ambystoma* larvae were collected in the vicinities of Maclennan and Desbarats on several dates from June 8 to July 6, but no adults were found. Larvae collected on June 8 in a muddy pasture pond devoid of vegetation and totally unshaded ranged in length up to 39.5 millimeters, the majority exceeding 23. On July 2 the maximum length of larvae in this pond was 50 millimeters. Two larvae from this pond transformed at 53.4 and 55.2 millimeters by July 13. They were *jeffersonianum*. The costal grooves, including the axial and inguinal, were 13 in most larvae examined, and 14 in a few. There were two or three with 12 grooves.

Plethodon cinereus (Green). RED-BACKED SALAMANDER.—This salamander was collected in the vicinity of Maclennan on dates from June 6 to 27. Ten specimens were taken, three had broken and partly regenerated tails, the others ranged in total length from 71 to 83 millimeters and averaged 77. The costal grooves were 17, 18 and 19. One specimen was dark without a red dorsal stripe; all the others had this stripe. A clutch of seven eggs was found on June 27 in a decaying pine long in the woods near Maclennan. Of the specimens with complete tails, six males averaged 77.9 millimeters of which the tail was .478; the single female was 72.3 millimeters of which the tail was .484.

Bufo americanus americanus Holbrook. AMERICAN TOAD.—This toad was reported by Williamson (1907, 37) from Heyden. It was found by our party in the vicinity of Maclennan, on St. Joseph Island, at Laird, Lake George, Black Hole Lake near Desbarats, and at Gros Cap. Twenty-six specimens (also some newly metamorphosed, and tadpoles) were collected. The former lot was lent to another museum some years ago and unfortunately is not at present available for examination.

Toads were often heard in song at evening from the date of our arrival on June 1 until July 17 (the latter date was recorded by Professor Coventry after the writer's departure). The recorded temperature range at which song was heard was from 51° to 67.5° F. Newly transformed specimens were found at Lake George on July 9. A lot of tadpoles and metamorphosing stages were taken at Black Hole Lake on June 29. In six of these all four limbs had appeared and in two more the front limbs were near to appearing; the remainder were still larval.

Some of the adult specimens collected showed much red on the under surface of the thighs and pelvic region and on the sides of the body.

Hyla crucifer (Wied). SPRING PEEPER.—The peeper was a common frog in the general area about Maclennan; we took it also at Lake George, at Black Hole Lake near Desbarats, and at Gros Cap. From June 1 until at least the 25th it was often heard calling at night with air temperatures from 44° to 63° F. Of seventeen specimens collected and measured, only six were females. The average head-body length of the males was 23.3 millimeters and that of the females 23.8. The males had an average head length of .325 and hind-leg-to-heel length of .837; for the females the corresponding figures are .331 and .844.

A newly hatched larva was taken on June 5 from a woodland pond near Maclennan; also two others of 7 and 8 millimeters. A lot of twenty-six tadpoles taken from a partly shaded pond south of camp on July 6 had a body length ranging from 8.5 to 10 millimeters. All had lost the terminal portion of the tail. The hind limbs ranged in development from small buds to advanced growth, and four or five specimens were nearing the appearance of the front limbs. These tadpoles were peculiar in being of an intense inky black which even suffused the normally clear areas of the tail membrane.

Rana catesbeiana Shaw. BULLFROG.—This frog was reported by Williamson (1907, 135) as "very common at the lower end of Stony Lake." Stony Lake is not named on the district map.

Rana clamitans Latreille. GREEN FROG.—We collected this frog in the general area about Maclennan, on St. Joseph Island, at Black Hole Lake, Caribou Lake, Point aux Pins, and at Gros Cap. The eighteen specimens collected are divided equally as to sexes. For the males we find an average head length of .377 of the head-body length with extremes of .366 and .394; for the females these figures are .366, .344 and .384. Tympanum to head proportions for the males average .325 with extremes of .246 and .400; for the females .288, .260 and .314, for specimens of 60 millimeters or more. The hind-leg-to-heel length averages .909 for all specimens, with extremes of .802 and .979.

One female full of eggs was taken on June 9 in a roadside ditch near Maclennan. Tadpoles were common in St. Joseph Channel and were also taken in a lake on St. Joseph Island. The first metamorphosing specimen was noted on June 22.

Rana palustris Le Conte. PICKEREL FROG.—Reported by Williamson (1907, 136) who took one specimen at Heyden.

Rana pipiens Schreber. LEOPARD FROG.—The leopard frog, next to the wood frog, was the commonest *Rana*. It was reported from Heyden by Williamson (1907, 135). It was collected by our party at Maclennan, St. Joseph Island, Lake George, Black Hole Lake near Desbarats, north of Portlock, near Little Rapids, and at Point aux Pins. Twenty-three specimens were collected. The largest male is 72.6 and the largest female 89 millimeters. The average head length is .340 of the head-body length with extremes of .311 and .383. The corresponding figures for the hind-leg-to-heel length are .954, .985 and 1.023. The shorter folds on the back between the dorsolaterals are moderately to well developed in all specimens and are from two to four in number, but often confused. The dorsolateral folds pass over the eye. The numbers of joints of the fourth toe free of web occur with the following frequency: 2 joints free .478, 2½ joints free .304, 3 joints free .217. The ground colour varied from green to brown and the spots in size and spacing; the banding of the femur and tibia was both complete and broken, and the posterior femoral vermiculation was variable but never broken completely into small isolated spots. The spot on the snout was present in thirteen specimens.

Williamson makes the following comments on five specimens collected at Heyden. "They are all small adults the coloration of which is close to that described as *Rana virescens brachycephala* by Cope, having no longitudinal band on the femur and having the tibial cross bars incomplete, also yellow bordered dorsal spots. However, the head is longer than in typical specimens of the variety *brachycephala*, and the muzzle is as acuminate as in most specimens of the variety *R. p. pipiens* and the size of the spots correspond with the latter variety."

Tadpoles were common in Maskinonge Bay. A lot of fifteen tadpoles collected there on June 5 ranged between 10 and 19 millimeters in length with no trace of limb buds showing. Subsequent collections were as follows: June 13, 44 tadpoles of from 23 to 42 mm.; June 26, 32 tadpoles of from 42 to 60 mm. These lots no doubt contained products of several spawnings. Metamorphosing specimens were present in a muddy pasture pond near Maclennan on July 2.

Rana septentrionalis Baird. Mink Frog.—Reported by Williamson (1937, 136) from Heyden, where four specimens, three males and a female, were taken.

Rana sylvatica Le Conte. Wood Frog.—This, the commonest *Rana*, was reported by Williamson (1907, 137) from Searchmont. It was collected by our party in the general area about Maclennan, at Laird, Lake George, St. Joseph Island, Pine Island, Black Hole Lake near Desbarats, Little Thessalon River west of Little Rapids, and at Gros Cap.

A hind-leg-to-heel length in excess of the head-body length occurs in six (6.8 per cent) of the eighty-seven specimens of all sizes collected in Algoma District as compared with 10.6 per cent for the province of Ontario at large. A hind-leg-to-heel length equal to the head-body length occurs in one (included among the short-legged specimens below). The following brief summary of characters noted in the Algoma material is from sixty-five adult specimens, thirty-two males and thirty-three females.

Short-legged specimens

Proportional measurements (59 specimens)

Hind-leg-to-heel length	average	.918	extremes	.842, 1.000*
Tibia length	"	.574	"	.446, .561
Head length	"	.341	"	.308, .365
Foot length	"	.738	"	.655, .820
Proportion of ear to eye	"	.644	"	.500, .780

Frequency of occurrence of other characters (58 specimens)

Extra folds between dorsolaterals well developed in	.517	(30 specimens)
" " " weak or fragmentary in	.413	(24 ")
" " " absent in	.068	(4 ")
Skin of back rough in	.241	(15 ")
" " medium in	.603	(35 ")
" " smooth in	.137	(8 ")
Joints of fourth toe free of web—two in	.086	(5 ")
" " " two plus in	.224	(13 ")
" " " three in	.689	(40 ")
Light dorsal stripe present in	.034	(2 ")

*Should we exclude this specimen from the short-legged group, the next longest would be .997.

Long-legged specimens

Proportional measurements (6 specimens)

Hind-leg-to-heel length	average	1.018	extremes	1.005, 1.040
Tibia length	"	.549	"	.542, .562
Head length	"	.349	"	.325, .369
Foot length	"	.803	"	.759, .853
Proportion of ear to eye	"	.642	"	.591, .682

Frequency of occurrence of other characters (6 specimens)

Extra folds between dorsolaterals well developed in	.333	(2 specimens)
" " " weak or fragmentary in	.333	(2 ")
" " " absent in	.333	(2 ")
Skin of back rough in	.166	(1 ")
" " medium in	.500	(3 ")
" " smooth in	.333	(2 ")
Joints of fourth toe free of web—two in	.166	(1 ")
" " " two plus in	.666	(4 ")
" " " three in	.166	(1 ")

Light dorsal stripe absent in all.

It will be seen from the above summary (and would be more apparent if characters of individual specimens were tabulated) that the leg length shows a fairly smooth gradient from short to long; all other measurements overlap. The ear averages larger in the short-legged specimens, and although the smallest ears occur in this group the largest ears also occur in it, and ears of over 70 per cent of the eye occur in nine (.152) of these, but not at all in the long-legged group. While a rough skin occurs more frequently in the short-legged specimens and a smooth skin in the long-legged, this may be either a local condition or an accidental result of the very small number of long-legged specimens in the series, since it is the reverse of our findings in a larger series collected widely over Ontario. The exactly even division among the long-legged specimens as to development of the shorter folds between the dorsolaterals might be assignable to either of the same causes (in our larger series from other localities also the frequency of absence of these folds is .366, and of strong development .122 in long-legged specimens). The foot averages longer in the long-legged specimens, but the lower extreme in these widely overlaps the upper in the short-legged specimens. An outer sole tubercle was present in all, except that in two specimens, a long-legged and a short-legged, it was absent on one foot. The internasal space was wider than the interorbital in all.

With leg-length presenting as smooth a gradient as it does, and with all other characters examined (characters that were selected because they have been used in the literature by various authors in describing, or distinguishing between, *R. sylvatica* and *cantabrigensis*) overlapping widely as between the two groups, there seems to be no very good reason in the present state of our knowledge for recognizing two forms among the Algoma wood frogs, or for distinguishing them from wood frogs collected at other Ontario localities.

A lot of thirty-three tadpoles collected on June 8 in a mossy pond partly shaded by scrub willow, near Maclennan, ranged from 24.6 to 37.6 millimeters in length; the limb buds (flexed) were from 1 to 2.3 millimeters. A lot of seventeen tadpoles taken on the same day from an open, unshaded pasture field pond nearby ranged in length from 36.5 to 45.3 millimeters; the limb buds (flexed) were from 2 to 8 millimeters. On July 2 metamorphosis was in progress in both of these ponds. The first metamorphosing specimens of the season were seen on June 19 in another open pond that was then drying up, and many young frogs were leaving the water.

A series of eight tadpoles taken in a pond in a gravel pit at Black Hole Lake near Desbarats were unusual in attaining a very large growth, 48.8 to 60.3 millimeters in length; the hind limbs (flexed) ranged from 6.7 to 11 millimeters although the tadpoles were completely larval. The dorsal fin rose abruptly to maximum height close to the base of the tail, giving the appearance of a greatly increased tail fin depth. Actually, the tail fin depth was in about normal proportion, averaging .284 of the total length of the tadpole with extremes of .253 and .323. The largest tadpole from any other Algoma locality was 45.3 millimeters. The length of the largest *sylvatica* tadpole reported by Wright (1929, 27) was 49.8 millimeters.

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A LIST OF SPIDERS COLLECTED IN THE SAULT STE. MARIE REGION, ONTARIO

By

T. B. Kurata

Field work in the Sault Ste. Marie region during the summer of 1931 was organized primarily to study and collect vertebrates. However Mr. E. B. S. Logier and others found it possible to collect a number of spiders. Representatives of ten families of Araneae have been identified and listed below.

DRASSIDAE

Drassus neglectus Keys. Maclennan: July 6, 1 ♀.
Drassodes robustus Em. Maclennan: July 6, 1 ♀.
Gnaphosa gigantea Keys. Point aux Pins: July 13, 1 ♀.
Zelotes atra H. Maclennan: July 6, 1 ♀.
" **depressa** Em. Maclennan: July 6, 1 ♀.

THERIDIIDAE

Crustulina guttata (Wilder.) Maclennan: July 6, 1 ♀.
Enoplognatha marmorata H. Maclennan: July 8, 1 ♀.
Theridion spirale Em. Point aux Pins: July 26, 4 ♀ ♀.

LINYPHIIDAE

Linyphia pusilla Sund. Laird: July 13, 1 ♀; July 16, 1 ♀.

ARGIOPIDAE

Araneus arabescus Walck. Point aux Pins: July 13, 1 ♀.
" **cornutus** H. Maclennan: July 25, 1 ♀.
" **trifolium** H. Maclennan: July 25, 1 ♀.
Tetragnatha extensa L. Lake George: July 9, 1 ♂. Laird: July 19, 2 yg.
" **laboriosa** H. Lake George: July 19, 1 ♀. Laird: July 1 yg.
" **pallidula** Bks. Maclennan: July 16, 1 ♀.

THOMISIDAE

Philodromus pernix Blackw. Maclennan: July 6, 1 yg.
Thanatus coloradensis Keys. Lake George: July 9, 1 yg.
Tibellus duttoni H. Lake George: June 19, 1 ♀.

CLUBIONIDAE

Clubiona riparia Koch. Laird: July 13, 1 yg.
Micaria gentilis Bks. Maclennan: July 16, 1 yg.

AGELENIDAE

Agelena naevia Walck. Maclennan: July 16, 1 yg.

PISAURIDAE

Dolomedes triton sexpunctatus H. Laird: June 19, 1931, 3 yg.,
A. F. Coventry.

LYCOSIDAE

Lycosa pratensis Em. Gros Cap: July 13, 1 ♀.
Pardosa milvina H. Laird: June 19, 1 ♀.
" **modica** Blackw. Lake George: July 9, 3 ♀ ♀.
" **moesta** Bks. Maclennan: July 6, 1 ♀.
" **xerampelina** Keys. Maclennan: July 16, 1 ♀.
Pirata arenicola Em. Lake George: June 9, 2 ♀ ♀.
" **insularis** Em. Point aux Pins: July 13, 2 ♀ ♀.

SALTICIDAE

Peckhamia picata H. Laird: July 3, 1 ♀.
Phidippus purpuratus Keys. St. Joseph Id.: June 22, 1 ♀.
Tutelina elegans H. Maclennan: June 18, 1 ♂.

A LATE PALAEOZOIC STENOPORID FROM BRITISH COLUMBIA

By MADELEINE A. FRITZ
Royal Ontario Museum of Palaeontology

INTRODUCTORY

The bryozoan discussed in this paper was obtained by J. E. Armstrong of the Geological Survey of Canada. The locality at which the fossil was found is a short distance southeast of Kloch Lake in the Cassiar district, British Columbia. It is situated on latitude 55° less than two miles west of longitude 125°.

The geological relationships of the rocks in this particular portion of the Rocky Mountains are not clear and the absence of well-preserved fossils which might have been a determining factor has added to the difficulties of the problem. When the bryozoan in question was discovered it was hoped that it would reveal some definite information that might assist in dating the rocks more closely than has hitherto been possible. In only a general way, however, has such been the case, since upon examination the fossil presented a combination of features which rendered its position in time open to question. The species appears to represent an intermediate stage in the development of the *Stenopora* group, a group of Bryozoa which broadly speaking flourished from the Devonian to Permian during which period it underwent considerable evolution before finally disappearing at the close of the Palaeozoic era.

The object of this paper is (1) to describe and figure this species for which the name *Eostenopora? klochensis* is proposed; (2) to consider the evolutionary trends represented by the form; (3) to discuss its possible geological and biological relationships.

DESCRIPTION OF THE SPECIES

Eostenopora? klochensis, sp. nov.

Plate I, Figures 1 and 2

External Features.—Only one fragmentary specimen firmly embedded in a solid limestone matrix is present. In consequence the external features of the zoarium are not exactly known. It consists of apparently smooth, cylindrical, dichotomous branches which measure from 4 mm. to 7 mm. in diameter.

Tangential Section.—Owing to the fact that the specimen could not be extracted from the limestone it was not possible to select an ideal surface for sectioning. There is no assurance that any part of the section is really close to the surface of the zoarium though it would seem that it is not far below.

The zooecia are subpolygonal, round to oval in outline, and somewhat irregular in size. They average from six to eight in 2 mm. Very small tubes are occasionally present. The walls are moderately thick. In a few places numerous small, granular acanthopores surround the zooecia. The probability is that these small acanthopores peter out at depth. Their scarcity, therefore, is an indication that the present section does not represent the outermost portion. At the junction of the zooecial walls larger acanthopores are developed but there is no tendency for them to inflect the walls.

Vertical Section.—Walls of the zooecia in the immature region are decidedly thin. The tubes bend abruptly towards the mature region opening directly to the surface. In the mature region the walls become appreciably thickened. The thickening is intermittent and in places distinctly moniliform. Diaphragms are thin and straight. They appear to be absent in the immature region, are sparingly developed in the submature region, are from one to two tube diameters apart in the mature region, and are even more abundant near the surface in certain zooecia. Imbricated layers of laminated tissue characteristic of the genus are well shown in sections of this type. Running through the centre of this tissue is a dark line which appears to be continuous rather than to be made up of isolated granules as suggested by Duncan in her generic description of *Eostenopora.*

Holotype. 1365. Geological Survey Collections, National Museum Canada. Microscopic slides 1365a; 1365B.

Occurrence. Mississippian, Cassiar district, north central British Columbia.

EVOLUTIONARY TRENDS REPRESENTED

There is no described genus in which this species can be accurately placed. The genera it most closely resembles are *Eostenopora* and *Stenopora.*

Eostenopora (1) is a recently established Devonian genus characterized by complete diaphragms and a wall structure which shows intermittent thickening in the mature region but which could not be termed moniliform. *Stenopora* (2) according to present usage is reserved for Carboniferous and Permian forms, non-tabulate, and with a distinctly moniliform wall structure in the mature region. Besides these two genera there is the biologically related group, essentially of late Palaeozoic age, that suggests and intermediate development and for which no generic name has been proposed. These forms possess well developed, complete tabulae, and moniliform walls. It is in the latter group that the present species most conveniently fits. When this group of fossils is more thoroughly understood it may be possible to draw a line of distinction between the earlier and later representatives of the tabulate stenoporids. Up to the present time such a step does not seem to be warranted.

GEOLOGICAL AND BIOLOGICAL RELATIONSHIPS

The species which *Eostenopora? klochensis* appears to resemble most closely are forms described by Lee (3) from the Lower Carboniferous of England. Among these species might be cited *Stenopora redesdalensis*, *S. obliqua*, *S. haddingtonensis*, and *S. castletonensis*. None of these forms can now be regarded as belonging to the genus *Stenopora* since its restriction by Bassler in 1941. It would seem that these species along with the present species and certain other North American forms constitute a natural group to which a new generic name might well be applied. Should the biological affinities be with the above mentioned British forms then it follows that this western Canadian fossil might be regarded as Mississippian in age. Such an age is also suggested by the evolutionary stage in development reached by the species which, as already noted, is intermediate between the Devonian *Eostenopora* and the genus *Stenopora*, a characteristic Permian bryozoan.

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DESCRIPTION OF PLATE

FIGURE 1.—*Eostenopora? klochensis* Fritz sp. nov. Tangential section X30 from Holotype No. 1365 Geological Survey Collections, National Museum Canada, Ottawa, Ontario. Microscopic section No. 1365A.

FIGURE 2.—*Eostenopora? klochensis* Fritz sp. nov. Vertical section X30 from Holotype No. 1365 Geological Survey Collections, National Museum Canada, Ottawa, Ontario. Microscopic section No. 1365B.

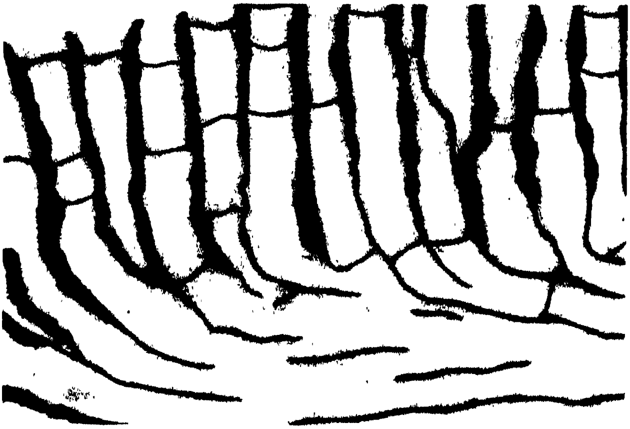

Figure 1

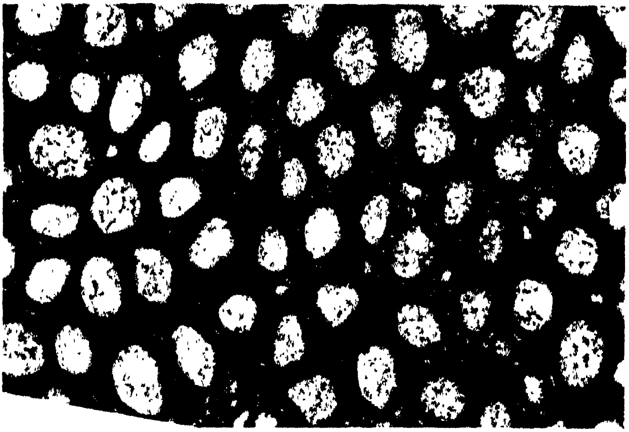

Figure 2

A LATE PALAEOZOIC STENOPORID FROM
BRITISH COLUMBIA

TRANSACTIONS

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THE COREGONINE FISHES OF NORTHWESTERN CANADA

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INTRODUCTION

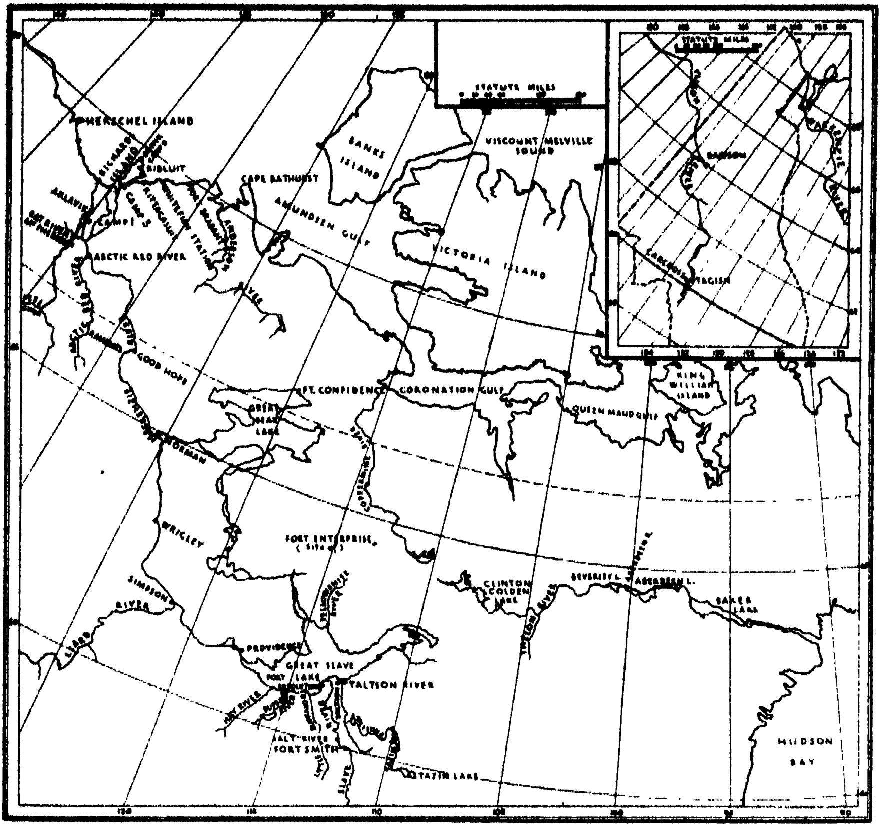
The latest check list of North American fishes (Jordan, Evermann and Clark, 1930) lists 12 members of the whitefish family (Coregonidae) as occurring in the northwest, only one of which, ***Prosopium quadrilaterale***, extends to the Great Lakes. In contrast to this, most of the other freshwater fishes of the area are regarded as belonging to species common in the Great Lakes region. Species common to the two areas include:

(1) *Cristivomer namaycush*, (2) *Catostomus catostomus*, (3) *Catostomus commersonii*, (4) *Moxostoma aureolum* (*lesueurii*), (5) *Esox lucius*, (6) *Stizostedion vitreum*, (7) *Cottus cognatus*, (8) *Pungitius pungitius*, (9) *Lota maculosa*.

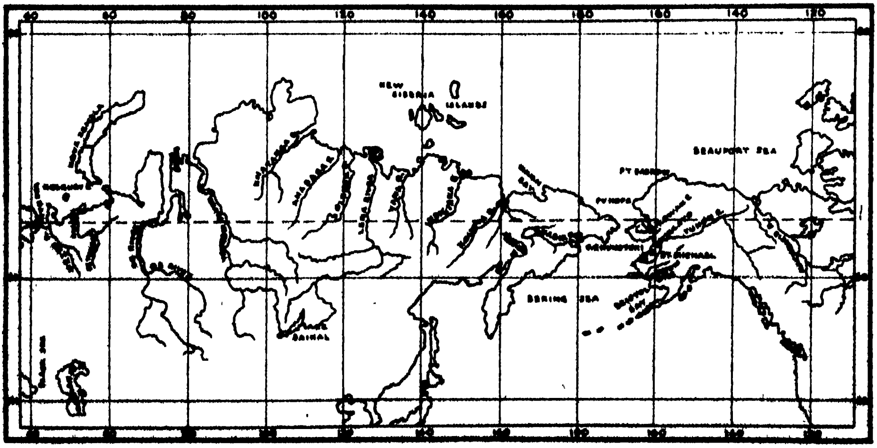
Similarly none of the northwest American and Siberian coregonines was considered as belonging to the same species, although at least three of the species listed above (*C. catostomus*, *Esox lucius*, *P. pungitius*) are known to extend across Canada and into Siberia and our *Lota* has since been regarded as of the same species as that of Europe and Asia.

It has long been doubted whether the coregonine fauna of northwestern America is actually as distinct as the 1930 check list would suggest. Two factors have, however, combined to retard an understanding of this fauna. The first of these is that, until recently, few specimens have been available for study; the second is the difficulty of understanding relationships within the group.

A history of the early explorations which contributed to our knowledge of the natural history of the Northwest Territories has been published by Preble (1908). Although fish were forced on the attention of every explorer and trader since they were a mainstay of the food supply of the early trading posts, most of the early explorers (Hearne, 1795; Mackenzie, 1801) merely record the presence of such fish as whitefish, inconnu, grayling, trout, pike, pike-perch, suckers and burbot. Hearne is credited with being the first to record the inconnu,—by description, not by name. The name, poisson inconnu, is first mentioned by Mackenzie. Richardson (1823, 1836), naturalist of Sir John Franklin's first and second expeditions, was the first who took any scientific interest in the fishes of the region. It was he who named and described *Prosopium quadrilaterale* (1823), *Leucichthys lucidus* (1836), *L. tullibee* (1836) and *Stenodus mackenzii* (1823) of the group considered in the present paper. Unfortunately, specimens collected during the first expedition had to be abandoned during the disastrous overland journey from the Arctic to Fort Enterprise. The Fauna Boreali-Americana which embodied the natural history results of Franklin's two expeditions



Map of Northwestern Canada showing location of places mentioned in the text.



Map of Northern Asia showing location of places mentioned in the text.

was for long the chief source of information on the natural history not only of the Northwest Territories but also of northern North America. It is still an invaluable source of information on northern animal life.

Robert Kennicott, beginning in 1859, spent between three and four years collecting in the Yukon and Mackenzie River region but according to Preble (1908) a considerable part of his collection was lost on the Methye Portage "probably having been thrown away by some weary and irresponsible voyageur". Of Preble's own collections of fish, he says "By some unfortunate accident, a considerable portion of the collection disappeared in the interval between its arrival in Washington and the time it could be examined. These lost specimens unfortunately included most of the examples of *Coregonus*—specimens which would have settled a number of doubtful points."

Occasional specimens collected by explorers, travellers, etc. are all that have hitherto been available for study. A history of the studies contributing to our knowledge is included in the discussion of the individual species.

The difficulty of coregonine systematics is due largely to the extent to which members of the group vary under different ecological conditions. Body form and other morphological characters vary from one body of water to another. Indeed Hart (1931) showed that *Coregonus* from different parts of the same lake (Lake Ontario) differed in their body proportions. Dymond and Hart (1927) found that *Coregonus* of Lake Abitibi differed from the same species of Lake Nipigon in the same respects as *Leucichthys nipigon* of Lake Abitibi differed from the same species of Lake Nipigon, suggesting that for each body of water there is a particular form to which different coregonines are moulded.

In the case of many, perhaps all species of fish, body proportions and some other characters change with growth. Hart (1931) found that for *Coregonus clupeaformis* the more prominent changes with growth are increases in relative body depth, interorbital width and length of fins on the ventral part of the body and the decreased proportionate size of the head and its parts, particularly the eye. Since whitefish in some bodies of water do not attain nearly as large a size as they do in others, direct comparison is apt to be misleading unless one has specimens of the same size. When one is dependent on commercial fishermen, trappers, etc., as has occurred in the case of Northwest Territories' coregonines, it is usually not possible to obtain specimens that are directly comparable.

Fortunately, there is little sexual dimorphism among the coregonines, although the subject has not yet been thoroughly explored. Hart (1931) found for *Coregonus clupeaformis* that males have larger fins in proportion to their size than females. He also obtained some evidence that males may also have a longer snout and a less deep body. Until the matter can be more fully investigated, there must be some doubt as to whether specimens of the same size are directly comparable unless they are of the same age and of the same stage of sexual development.

The sort of differences that complicate the comparison of specimens of different sex and size especially if they have developed under conditions that affect rate of growth are illustrated by a consideration of the Kamloops trout. Mottley (1936) has shown that in this species the head increases in length at a slower rate than the body in the case of smaller trout and at a faster rate in the larger specimens. The change from negative to positive heterogony (Huxley, 1932) occurs at the onset of sexual maturity. Males show a greater positive heterogony throughout the large-size groups. Since trout do not all mature at the same age or the same size, there is much variability in the size at which positive heterogony begins. The snout increases in length at the same rate as the body in the case of small males but more slowly in small females; in larger fish both males and females show positive heterogony but it is more strongly marked in males than in females. The positive heterogony of the snout length and also of the head length of the larger fish is due mainly to the relative rate of growth of the pre-ocular region. The length of the maxillary process corresponds closely to the length of the snout in its growth characteristics. The eye increases in size at a rate less than that of the body in both small and large trout but the negative tendency is greater in females than in males. In smaller trout the body undergoes extension in length at a faster rate than extension in depth or width but in larger fish this trend is reversed and positive heterogony sets in. Caudal peduncle length is relatively greater in small fish than in larger ones. Similar changes, though often less marked, characterize the growth rate of other characters such as interorbital width, caudal peduncle length and depth and fin lengths.

Body proportions are not affected to the same extent by growth and sex in the coregonines as they are in salmonid fishes. Nevertheless, Hile (1936) showed that permanent morphological differences exist between different year classes of the same population of *Leucichthys artedi* and Koelz (1927) discussing whitefish reared in the New York Aquarium from eggs of Lake Erie parents reports that "the body parts show great modifications in all the specimens and none of them closely resemble any whitefish taken in the Great Lakes. The most striking differences are changes in the shape of head parts. The head throughout is much deeper than in normal whitefish and its dorsal contour usually is decurved conspicuously anterior to the orbit. The premaxillaries are often vertical in position, which is not known to be the case in normally reared individuals. The head is broader, especially across the snout, and the adipose is much larger usually". After comparing measurements of various characters, he concludes "It is clear that the artificially reared specimens have a proportionately longer head, eye, maxillary, snout and paired fins and fewer gill-rakers than naturally reared fishes—aquarium conditions thus have produced or permitted the development of individuals that are strikingly different from those that are found in nature. Even characters that are considered generic, such as the position of the premaxillaries, have been altered."

The number of gill-rakers is usually one of the least variable of the characters used to distinguish species but Thienemann (1912), Surbeck (1921) and Kreitmann (1929) as quoted by Hile (1936) have all shown that the number of gill-rakers was changed in various species of coregonines following their introduction into new habitats.

The difficulties of coregonine systematics are therefore due to extensive modifications produced by the direct action of the environment superimposed on whatever genetic differences characterize the different populations.

SPECIMENS AVAILABLE FOR STUDY

Following is a list of the specimens which I have had available for study in the collections of the Royal Ontario Museum of Zoology. The names of the persons to whom the Museum is indebted for procuring the specimens are indicated in the case of each collection. The collection, preservation and shipment of these specimens has often involved considerable time and trouble. Our thanks are extended to each for his contribution to the present study; without their co-operation this work could not have been undertaken.

Locality	Number of specimens	Collector
Coregonus		
Kittigasuit	11	K. H. Lang
Peel River	18	K. H. Lang
Squanga Lake, Yukon Territory	6	Alfred Dickson
Yukon River near Dawson	3	James Hughes
Arctic Red River	5	R. W. Dodman
Baker Lake and vicinity	8	C. H. D. Clarke
Prosopium		
Yukon River at Dawson	5	James Hughes
Baker Lake and vicinity	6	C. H. D. Clarke
Great Bear Lake	1	M. Meikle
	3	Hudson's Bay Co.
Clinton Colden Lake	1	C. H. D. Clarke
Rutledge River (tributary to Great Slave Lake via Taltson River)	3	Frank Conibear
Lesser Slave Lake	1	T. F. Blefgen
	5	R. B. Miller

Locality	Number of specimens	Collector
Leucichthys		
Kittigasuit	2	K. H. Lang
Kidluit	9	K. H. Lang
Tuktuyaktok (Port Brabant)	2	K. H. Lang
Aklavik (Whitefish station)	16	K. H. Lang
Peel River	1	K. H. Lang
Yukon River near Dawson	1	Jas. Hughes
Arctic Red River	6	R. W. Dodman, Hudson's Bay Co.
Baker Lake and vicinity	5	C. H. D. Clarke
Great Bear Lake	2	M. Meikle
	2	G. E. Duncan
	4	Hudson's Bay Co.
	4	G. A. LaBine
Stenodus		
Peel River	2	K. H. Lang
Yukon River near Dawson	1	James Hughes
Arctic Red River	1	R. W. Dodman
Fort McPherson	2	John Patterson
Slave River at Fort Smith	12	Frank Conibear
	1	George Whitely
Coregonus x *Stenodus* hybrid		
Kidluit	4	K. H. Lang

In addition to our own collections, I examined the following material in the United States National Museum. For this privilege, I am indebted to Dr. Leonard P. Schultz, Curator of Fishes, to whom my thanks are extended.

Coregonus kennicotti	Type. no.	8971	Fort Good Hope, N.W.T.
"	"	29904	St. Michaels, Alaska
nelsonii	"	38935	Kowak River, Alaska
"	"	38926	" " "
"	"	29898	Nulato, Alaska
"	"	29900	" "
Prosopium oregonium	Type. no.	62987	McKenzie River, Ore.
Leucichthys pusillus	" "	38366	Kowak River, Alaska
Leucichthys laurettae	" "	27695	Pt. Barrow, Alaska
	(4 specimens)		

In the British Museum (Natural History) I had an opportunity to examine a specimen of the Asiatic *Coregonus nasus* from the lower Ob River. For this privilege I owe my thanks to Mr. J. R. Norman, Assistant Keeper, Department of Zoology.

In the National Museum of Canada, where the types of the species of *Leucichthys* from northwestern Canada described by Harper and

Nichols (1919) are stored, I was accorded the privilege of examining them by Dr. R. M. Anderson, Chief of the Division of Biology.

A specimen of *Coregonus* from Beauvert Lake, Alberta, was kindly loaned me for examination by Dr. D. S. Rawson, Department of Biology, University of Saskatchewan.

The collections of the Royal Ontario Museum of Zoology contain large series of specimens of *Coregonus*, *Prosopium* and *Leucichthys* from the Great Lakes, Hudson and James Bays and the Prairie Provinces, which have been available for purposes of comparison.

METHODS OF MAKING MEASUREMENTS AND COUNTS

For ready comparison of size of body parts, actual measurements of head length, head depth, eye, snout, body depth and width, fin lengths, etc., have been divided by standard length and the resulting proportions expressed as thousandths of the standard body length. Thus an actual head length of 79 mm., in the case of a fish 393 mm. long to end of vertebral column, is represented as head length 201.

In most cases measurements were made as described by Koelz (1929).

Standard length was measured from the junction of the premaxillaries to the end of the last vertebra.

Total length was measured to the end of the middle ray of the caudal fin and is expressed in inches, unless otherwise stated.

Interorbital is the least distance as measured by dividers across the bony part of the skull between the orbits.

Caudal peduncle length is the distance in a straight line from a point on the lateral line vertically above the posterior insertion of the last ray of the anal fin to the end of the last vertebra.

Caudal peduncle depth is the least depth of the caudal peduncle.

Dorsal and anal fin lengths are the lengths of the longest rays.

Pectoral and ventral fin lengths were measured from the anterior edge of the structural base of the fins to the tip of the longest ray.

All of the unbranched rays at the front of the fins, no matter how short, were counted. These have been added to the number of branched rays and the total number indicated as the number of fin rays. The last ray of the dorsal and anal fins was counted as one, even though divided to the base and appearing as two separate rays.

Adipose length is the distance as measured by dividers from the anterior insertion of the fin to its farthest tip.

Lateral line scales were counted only to the end of the vertebral column.

Gill-rakers were counted as described by Koelz, every visible raker being included in the count.

NOMENCLATURE

There has been some variation in the spelling of a number of the specific names of the species discussed in the present paper. In quotations, direct or indirect, the spelling of the author concerned has been retained; elsewhere the spelling of the original description or the one now in general use has been adopted. Thus *clupeiformis* will be found in quotations from earlier authors, whereas *clupeaformis* is the spelling used elsewhere in the paper.

COREGONUS

Apparently the first scientific name by which the whitefish of Canada was known was *lavaretus*, the name under which Pennant (1785) referred to the whitefish of Hudson Bay.

Richardson (1823, 1836) considered the whitefish of northwestern Canada, of which he must have seen many thousands, as identical with that of the Great Lakes, for he describes it under LeSueur's (1818) name *albus*, the specific name then used for the Great Lakes *Coregonus*.

In 1866, Günther introduced the name *richardsonii* for the whitefish of Arctic America, which he said was "very closely allied to *C. albus*, from which it differs in the form of the maxillary". He described the maxillary as extending "to the anterior edge of the eye, and its length is one-fourth that of the head. The supplementary bone of the maxillary is short, broad, semicircular". He gave the lateral line scales as (72-) 77-80 but failed to give the number of gill-rakers. Nor did he give the locality from which any of the specimens on which his description was based were obtained. His specimens of *richardsonii* he listed as:

a. Nineteen inches long: stuffed. Presented by J. Rae, Esq.
b-c. Nineteen inches long: stuffed. From the collection of the Zoological Society.

He also said "I have seen another example from the Museum at Haslar Hospital, also stuffed, and 22 inches long, presented by Sir J. Richardson to the latter institution, but without indication of locality."

As northwestern Canada and Alaska have a similar fish fauna, the history of the nomenclature of Alaskan whitefishes is of interest in the present connection.

Dall (1870, 1871) refers to the true whitefishes (*Coregonus*) of Alaska under the names broad whitefish (*Coregonus muksun*) and humpback (*Coregonus* sp. indet.). However, Jordan and Copeland's (1877) check list of the fresh-water fishes of North America does not include any reference to northwestern *Coregonus*. Bean (1882 c) included the true whitefishes of Alaskan and adjacent waters under the name *clupeiformis* and gave its range as the Great Lakes region to the Polar Sea, including

Alaskan localities. In Jordan and Gilbert's Synopsis (1883) two species are recognized, *kennicotti* and *clupeiformis*. The latter was regarded as the whitefish of the "Great Lakes and northward". By "northward" they intended to include the Arctic coast of the Northwest Territories since they include *richardsonii* among the synonyms of *clupeiformis*. The name *kennicotti* was given by Milner (1883) in Jordan and Gilbert's Synopsis to the form designated by Dall and later by Bean (1884, 1890) as broad whitefish. This, he said, was "a strongly marked species, well distinguished among the American forms by the very obtuse head, but perhaps identical with some Siberian species". His description mentioned "back not greatly elevated. Head very short and deep . . . maxillary extremely short and broad, not quite reaching to the eye . . . its supplemental bone broad ovate, broader than *clupeiformis*. Gill-rakers as in *C. quadrilateralis*" but he did not specify either the number or length of gill-rakers. "Types Nos. 8971 and 9600 of the United States National Museum from Fort Good Hope, British America, and Yucon River, Alaska, respectively".

In 1885 Bean gave the name *nelsonii* to the form known as the humpback whitefish in the northwest. In his original description he says it may readily be distinguished from *clupeiformis* by its greatly arched and much compressed back.

Bean in several papers (1884, 1885b, 1888, 1890, 1894) regarded the whitefishes of the northwest as belonging to two species, one he consistently called *nelsonii*, the name he had proposed for the humpback whitefish, the other he sometimes called *richardsonii* and sometimes *kennicotti*. For instance, in 1890 he wrote "the largest one (*Coregonus richardsonii*) sometimes reaching a weight of thirty pounds. For many years this was believed to be identical with the common whitefish of our Great Lakes fisheries, but it differs from this in many particulars. This species was known to the Russians as the "muksun" . . . . This is the species which Milner named *Coregonus kennicotti*". With reference to the relationship between the whitefishes of the Great Lakes and those of the northwest Bean in 1888 stated that *clupeiformis* "the common whitefish of the Great Lakes" did not extend "very far into British America and is replaced northwestward in Alaska and the Arctic portion of British America by *Coregonus richardsoni* (*kennicotti* of late works)".

Jordan and Evermann's (1896) check list included the following northwestern whitefishes:

Coregonus kennicotti—Broad whitefish; muksun of the Russians. Mackenzie and Yukon Rivers.

Coregonus richardsonii—Arctic North America.

Corogonus nelsonii—Humpback whitefish. Alaska from Bristol Bay northward.

It is stated positively that *clupeiformis* is "not in Alaska nor Arctic America". Evermann and Smith (1896) listed the same three species from northwestern localities. Evermann and Goldsborough (1907a) in their Fishes of Alaska listed only *kennicotti* and *nelsonii*.

The 1911 Review by Jordan and Evermann dropped *richardsonii* without listing it in the synonymy of any other species and regarded the northwestern whitefishes as belonging to *nelsoni* and *kennicotti*. The 1930 check list of Jordan, Evermann and Clark continued to regard the northwestern whitefishes as belonging to the same two species, *nelsonii* and *kennicotti*. *C. richardsonii* was listed questionably in the synonymy of *clupeaformis*, the whitefish of the "Great Lakes, excepting Lake Erie; and neighboring waters", a rather illogical procedure.

As a result of Bean's statement about the gill-rakers of *kennicotti*, this species has long continued to be erroneously considered as allied to *quadrilateralis*. Jordan and Evermann in their 1896 and 1911 publications list *kennicotti* under subgenus *Prosopium*. In 1896 *richardsonii* was also so listed, but by 1911 *richardsonii* had been dropped. The 1930 check list included *kennicotti* under *Prosopium* which had now been raised to generic rank.

Gilbert (1895) reporting on a specimen from the Delta of the Mackenzie River identified as *kennicotti* said: "This species is in many respects midway between *Prosopium* and *Coregonus*. The gill-rakers are short and few in number, but are slender. The preorbital is very long and narrow and the supplemental bone broad and ovate. Thus the gill-rakers are about as in *quadrilateralis* and other species of the section *Prosopium*, while all the other characters given ally the species with *clupeiformis* and the rest of the *Coregonus* group."

Evermann and Goldsborough's (1907a) Fishes of Alaska said that it (*kennicotti*) may be readily distinguished from the round whitefish found in the same waters by the somewhat larger mouth, longer and more numerous gill-rakers, large and much more caducous scales, and more elevated back."

There is a good deal of variation in the length of gill-rakers of northwestern whitefish. This is well shown by 2 specimens from Kittigasuit, one of which, 367 mm. in standard length, had gill-rakers 8 mm. in length, while the other, 378 mm. long, had gill-rakers only 4 mm. long. These are respectively 2.18 and 1.06 per cent of the standard lengths of the fish. Similar differences are shown by the gill-raker lengths of a series of specimens from the same locality. Unfortunately, these specimens are represented by skins only, so that the lengths could not be determined as accurately as in the case of whole specimens. However, the wide range in gill-raker length should be obvious from the following list.

Estimated standard length	Gill-raker length	Estimated standard length	Gill-raker length
494	6	415	6
481	7	410	7½
454	5	400	8½
444	10	388	5
421	12		

The same difference is not apparent in the case of specimens from Baker Lake nor from Arctic Red River as shown by the following measurements:

Standard length	Gill-raker length	Standard length	Gill-raker length
Baker Lake		Arctic Red River	
455	8	426	8½
427	6½	417	9
423	7	393	7
422	7½	374	7
417	7	370	7
408	7		
403	7½		
337	6½		

For comparison, the gill-raker lengths of Lake Ontario and Lake Nipigon whitefish are presented below.

Standard length	Gill-raker length	Standard length	Gill-raker length
Lake Ontario		Lake Nipigon	
435	8	363	7
420	8	358	7 1/3
417	9	349	7
392	8	344	6
388	6	342	5½
356	7	341	6
342	8	340	6
338	7	334	6
333	7	328	7
327	7		

When I examined the type specimen of *kennicotti* in the United States National Museum, I recorded its gill-rakers as being between 5 and 6 mm. in length and the standard length as 477 mm.

Thus the reduced gill-raker length that has long been regarded as characteristic of northwestern whitefish is not general; it appears to be exceptional rather than general. May it be that the reduced length is in some way related to the brackish water sojourn of some individuals? It will be noticed that individuals with specially short rakers are much more common among Kittigasuit specimens. North of Kittigasuit the water begins to turn brackish, according to Mr. Lang.

COMPARISON OF NORTHWEST AND GREAT LAKES COREGONUS

There is considerable variation among the whitefish of the genus *Coregonus* in the Northwest Territories. Table 1 presents measurements and counts for collections from a number of localities; where two or more specimens are included in a collection the values given are averages.

Specimens from some localities show considerable divergence from the whitefish of the Great Lakes, while others correspond rather closely to some forms found in these bodies of water. The number of gill-rakers in Great Lakes specimens usually lies between 26 and 29, with an average of slightly more than 27 (Koelz, 1929). Northwest Territory specimens usually have 21 to 26 gill-rakers (extreme range 18 to 27). Those from Kittigasuit and Peel River average about 23, Yukon River about the same, Arctic Red River and Baker Lake 25 or 26, but six specimens from Squanga Lake, near Dawson, Yukon Territory, average 28 with a range of 26 to 30. The type of *kennicotti* has 21. A specimen from St. Michaels, Alaska, labelled *kennicotti* in the United States National Museum has 20 gill-rakers, as had one reported by Gilbert (1895) from the Delta of the Mackenzie River. In his description of *nelsonii* Bean gave the gill-rakers as "about 26". I have not seen the type of *nelsonii* but four specimens from Alaska in the United States National Museum labelled *nelsonii*, two from Nulato, the type locality for the species, and two from Kowak River had gill-rakers respectively 23, 21, 21 and 21. Six specimens from Grantley Harbour and Renideu Station, Port Clarence, identified as *nelsonii* by Scofield (1899) had an average of 20 rakers. Berg gives the range of gill-raker numbers of the Siberian *nasus* as 19 to 25. A single specimen which I examined in the British Museum had 22.

It therefore appears that a number of areas in the Northwest and Yukon Territories and Alaska have whitefish which in gill-raker count are similar to the Siberian *nasus*, while within the same region occur whitefish showing almost perfect gradation in gill-raker number between *nasus* and typical *clupeafornis* of the Great Lakes, for example Kittigasuit, Peel River and Yukon River 22-23, Arctic Red River 25, Baker Lake and Thelon River 25-26, Hudson Bay 26-27, Great Lakes 27-28.

Great Lakes whitefish have an average of 82 or 83 scales with a range of 77 to 88 (extreme range 73 to 94) (Koelz, 1929). Whitefish from Kittigasuit and Squanga Lake have 84 to 86 scales on the average but Peel River, Yukon River and Arctic Red River whitefish have practically the same scale count as Great Lakes specimens, while Baker Lake and Thelon River specimens have a much lower number. The type

TABLE No. 1

PROPORTIONATE MEASUREMENTS AND COUNTS OF BODY PARTS OF *Coregonus* FROM DIFFERENT LOCALITIES

	Kittigasuit	Peel River	Squanga Lake	Yukon River	Arctic Red River	Baker Lake	*kennicotti*	*kennicotti*	*nelsonii*	*nasus*
Number of specimens	2	17	6	3	5	8	1 (type)*	1 (Alaska)	4	1
Standard length	373	355	247	356	396	411	477	445	363	333
Scales	85	83	86	82	83	77	90	85	81	90
Gill-rakers	22	22.8	28	22.3	25	25.8	21	20	22	22
Branchiostegals	7.5	8.2	8.4	8	8	8.2	9	8	8.8	8
Pyloric caeca	148	159	191	169	159	180				
Head length	208	210	213	205	200	209	189	202	205	199
Head depth	147	155	144	149	141	143	149	157	143	153
Eye	44	42	53	45	42	40	40	43	45	44
Snout	50	54	54	58	54	58	46	52	54	45
Interorbital	64	65	66	65	61	62	62	71	64	63
Maxillary	55	56	60	55	58	63	46	51	57	44
Body depth	287	296	243	245	285	241	210	254	254	312
Body width	148	147	125	152	129	148	...	130	109	93
Caudal peduncle										
Length	105	107	106	106	112	120	134	106	112	96
Depth	91	101	86	90	92	85	...	99	89	102
Dorsal rays	14	13	12	13.3	14.4	12.7	13	14	13.5	12
Dorsal height	173	192	172	188	183	172	165	157	156	201
Dorsal base	137	141	123	129	137	...	...	...	...	135
Anal rays	14.5	13.5	12.5	13.3	14.6	13	15	14	13.5	16
Anal height	130	140	118	143	134	122	...	...	...	156
Anal base	127	130	117	119	132	...	...	...	...	153
Pectoral length	173	196	186	183	172	174	172	181	161	192
Ventral length	164	181	173	176	165	167	165	157	146	186
Adipose	83	86	...	...	81	78	80	88	85	80

*The type specimen of *kennicotti* is a skin. Because of the impossibility of being certain of the standard length and certain other measurements, such as body depth and width and caudal peduncle length and depth, the measurements indicated must be regarded as merely approximate. For that reason they are not used in the comparisons based on this table.

of *kennicotti* had 90 scales; this is outside the range shown by the eleven Kittigasuit specimens (80 to 88) but within the range of the 17 Peel River specimens (78-93). The other specimen labelled *kennicotti* in the United States National Museum collection had 85 scales. A specimen from the Delta of the Mackenzie River reported as *kennicotti* by Gilbert (1895) had 90 scales on one side and 87 on the other. Two specimens from Barter Island near the mouth of the Mackenzie River identified as *kennicotti* by Scofield (1899) had 86 scales. Five from Grantley Harbour which the same author identified as *nelsonii* had an average of 83 (80-88). The type of *nelsonii* was said to have 88 scales (Bean 1885a). The four Alaska specimens of *nelsonii* in the United States National Museum had 79, 79, 82 and 82 scales respectively. Berg (1936) gives the number of scales in the Siberian *nasus* as 85 to 105. The single specimen of *nasus* which I examined in the British Museum had 90 scales.

In number of scales there is little difference between Northwest Territories and Great Lakes whitefish. The only population examined which shows a divergence is that of Baker Lake and Thelon River which averaged 77 scales, with a range of 70 to 85. It is perhaps significant that specimens (32) from Hudson and James Bay, into which Baker Lake and Thelon River drain, were found to have an average of 77 scales, with a range of 71 to 83. Hudson Bay whitefish had, however, gill-rakers intermediate in number between those of Baker Lake and the Great Lakes.

The difficulty of comparing body proportions of fish of different sizes has already been discussed. In an effort to overcome this difficulty so far as our present knowledge permits, tables 2 and 3 have been constructed. Here fish from various localities are compared with a common standard, namely Lake Nipigon whitefish. For each of the characters,—head, eye, body depth, etc.,—there is given under A the proportionate measurements for specimens from the localities indicated; under B, the proportionate measurements of whitefish of the corresponding length from Lake Nipigon and under C the difference between the proportionate measurements of specimens from the locality indicated and those from Lake Nipigon.

Lake Nipigon whitefish have been chosen as a basis of comparison because for many of the body characters of these fish Hart (1931) has given curves from which may be obtained the proportionate measurements of the part for any given length of specimen. These measurements and sizes are of course average ones. For characters for which Hart does not give curves he gives proportionate measurements (his table V) for a wide variety of sizes of fish. The localities listed in these tables correspond to those listed in table 1 except for Lake Ontario. In order to provide a basis of comparison with specimens from one of the Great Lakes, the values for Lake Ontario specimens from Pleasant Point are included. These were taken from Hart's results, presented in his table IV.

Table 2 indicates that whitefish from all of the localities represented had relatively shorter heads than those from Lake Nipigon. The shortest headed fishes were those from Arctic Red River (−14) which were of the same relative length as the British Museum specimen of *nasus*. In order of increasing length of head came fish from the following localities,—Lake Ontario (−12), Yukon River and a specimen labelled ***kennicotti*** from Alaska (−8),* four specimens of ***nelsonii*** (−7), Kittigasuit and Baker Lake (−5), Squanga Lake (−4), Peel River (−3) and Lake Nipigon (0).

In spite of having shorter heads, fish from three of the localities had larger eyes, ***kennicotti*** (Alaska) (+4), Squanga Lake (+3) and Kittigasuit (+0.5). Three of the populations have eyes of equal size to those of Lake Nipigon,—Yukon River, Arctic Red River and four specimens of ***nelsonii***, while four had smaller eyes,—Peel River (−3), Lake Ontario (−2.5), Baker Lake and *nasus* (−1.5).

While the shorter heads (as compared with those of Lake Nipigon whitefish) of the ten collections represented in table 2 do not have correspondingly small eyes, they do all have shorter snouts. The shortest-headed forms, however, are not usually those having the shortest snouts. *C. nasus* is the shortest snouted form (−15), followed in order by Kittigasuit (−11), ***kennicotti*** (Alaska) and Arctic Red River (−7), Peel River and ***nelsonii*** (−6.5), Squanga Lake (−5.5), Lake Ontario (−4), Baker Lake (−3) and Yukon River (−2.5).

In their descriptions of *richardsonii* and ***kennicotti***, Günther and Bean stress the length and shape of the maxillary. Günther said that in the whitefish of Arctic America which he named *richardsonii* the maxillary extends to the anterior edge of the eye and that the supplementary bone is short, broad and semicircular. Bean in his description of ***kennicotti*** said "maxillary extremely short and broad, not quite reaching to the eye . . . its supplemental bone broad, ovate, broader than *clupeiformis*".

There is very little difference between northwestern and Great Lakes whitefish in the matter of the backward extension of the maxillary relative to the eye. In some northwestern specimens the maxillary does not quite reach a vertical through front of eye, whereas in many Great Lakes specimens it projects slightly beyond such a vertical. It is, how-

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*Measurements for the type specimen of ***kennicotti*** are not included in these comparisons since the type is a skin, the measurements for which are not dependable because of the impossibility of being certain of the standard length.

TABLE No. 2

PROPORTIONATE MEASUREMENTS OF BODY PARTS OF *Coregonus* FROM DIFFERENT LOCALITIES (A), COMPARED WITH SIMILAR MEASUREMENTS OF LAKE NIPIGON FISH OF COMPARABLE SIZE (B). (C) IS THE DIFFERENCE

Locality	Length	Head			Eye			Snout		
		A	B	C	A	B	C	A	B	C
Kittigasuit	373	208	213	− 5	44	43.5	+0.5	50	61	−11
Peel River	355	210	213	− 3	42	45	−3	54	60.5	−6.5
Squanga Lake	247	213	217	− 4	53	50	+3	54	59.5	−5.5
Yukon River	356	205	213	− 8	45	45	+0	58	60.5	−2.5
Arctic Red River	396	200	214	−14	42	42	+0	54	61	−7
Baker Lake	411	209	214	−5	40	41.5	−1.5	58	61	−3
kennicotti (Alaska)	445	202	210	−8	43	39	+4	52	59	−7
nelsonii	363	205	213	−7	45	45	0	54	60.5	−6.5
nasus	333	199	213	−14	44	45.5	−1.5	45	60	−15
Lake Ontario	410	202	214	−12	39	41.5	−2.5	57	61	−4

TABLE No. 3

PROPORTIONATE MEASUREMENTS OF BODY PARTS OF *Coregonus* FROM DIFFERENT LOCALITIES (A), COMPARED WITH SIMILAR MEASUREMENTS OF LAKE NIPIGON FISH OF COMPARABLE SIZE (B). (C) IS THE DIFFERENCE

Locality	Length	Body depth			Caudal peduncle length			Height dorsal fin		
		A	B	C	A	B	C	A	B	C
Kittigasuit	373	287	278	+9	105	118	−13	173	176	−3
Peel River	355	296	272	+24	107	119	−12	192	177	+15
Squanga	247	243	245	−2	106	117	−11	172	183	−11
Yukon River	356	245	272	−27	106	119	−13	188	177	+11
Arctic Red River	396	285	285	0	112	118	−6	183	174	+9
Baker Lake	411	241	287	−36	120	122	−2	172	172	0
kennicotti (Alaska)	445	254	300	−46	106	127	−21	157	168	−9
nelsonii	363	254	274	−20	112	119	−7	156	177	−19
nasus	333	312	268	+44	96	120	−24	201	179	+22
Lake Ontario (Pleasant Point)	410	267	287	−20	118	122	−4	152	172	−20

ever, the greatly shortened snout of specimens from such localities as Kittigasuit and Arctic Red River that produces the relatively broad maxillary. It is the shortening of the snout that is the significant feature of these fish and as we have seen, there is every gradation in this character between the short snout of Kittigasuit fish and the long-snouted Nipigon fish.

A glance at table 3 is sufficient to show the wide variation in body depth among northwestern whitefish. Kittigasuit and Peel River specimens are the only ones having deeper bodies than those from Lake Nipigon. The Arctic Red River specimens are of the same depth as Lake Nipigon specimens. All of the others have less deep bodies, as have also the Lake Ontario whitefish. The specimen of *nasus* had by far the deepest body of any of the specimens examined (+44), followed in order by Peel River (+24), Kittigasuit (+9), Arctic Red River (0), Squanga Lake (−2), *nelsonii* and Lake Ontario (−20), Yukon River (−27), Baker Lake (−36) and *kennicotti* (Alaska) (−46).

In a number of areas in the northwest, a "crooked back" or "humpback" whitefish is distinguished from the more common form by the local people. The "crooked back" is similar to the humpback or bowback whitefish of Lake Erie in possessing a pronounced hump at the nape. Richardson (1823) noted this tendency in the northwestern whitefish remarking "When very fat the shape of the fish is somewhat distorted, as it acquires a hump immediately behind the head." My correspondent, Mr. K. H. Lang, believes that the humpbacks run by themselves and do not breed with the common whitefish. The flesh of the common whitefish, according to Mr. Lang, is slightly pinkish tinted, generally fat and firm; the spawn is pale yellow. The humpback, he says, has a more pointed snout, as well as a more pronounced hump. Its flesh is pale whitish and dry and inclined to be mushy when boiled; the spawn has a strong orange tint. According to Mr. Lang, the Eskimos distinguish between the two forms, calling the common whitefish *Anaklik* and the humpback, *Pekoktuk*.

Dall (1871) also reported a difference in the nature of the flesh between the humpback and broad whitefish. The former he described as "rather bony and inferior in flavor. It is generally used as dog feed, except in times of scarcity." The broad whitefish he said was "usually very fat and excellent eating."

Both common and humpback whitefish as recognized locally were among the specimens sent me by Mr. Lang but I was unable to find any other characters such as a different number of gill-rakers or scales correlated with the humpbacked condition. It is possible that, if the two forms are distinct, they belong to what may be regarded as physiological races and have not diverged morphologically sufficiently widely to be recognizable in view of the wide morphological variation exhibited by the whitefishes. Further research based on more adequate material may reveal differences between the so-called humpback and common whitefish of the northwest that merit nomenclatural recognition, but such differences are not shown by the material now available. The humpback whitefish of Alaska was given the name *nelsonii* by Bean (1885a) presumably on the basis of its humpbacked condition. However in his key (1884) he distinguished *clupeaformis* and *nelsonii* as follows:

Nape arched and thick, gill-rakers 26-29 . . . . *clupeiformis*
Nape arched and much compressed; gill-rakers 26 . . . . *nelsonii*

It would therefore appear that the compression of the arched nape was the feature by which he distinguished the two forms. I have not seen the type of *nelsonii* but none of the other northwestern whitefish which I have examined can be distinguished from Great Lake specimens on the basis of the compresssion of the arched nape.

The length of the caudal peduncle is one of the characters which show wide variation among the specimens examined. All were shorter than this character in Lake Nipigon specimens. The shortest was the specimen *nasus* (−24). The others in order of increasing length were *kennicotti* (Alaska) (−21), Kittigasuit and Yukon River (−13), Peel River (−12), Squanga Lake (−11), *nelsonii* (−7), Arctic Red River (−6), Lake Ontario (−4), Baker Lake (−2).

Length of fins is another quite variable character. There are long-finned and short-finned variants. Usually all the fins vary together,—all the fins will be long or all short. In table 3 the height of the dorsal fin has been taken as an index of fin length. Again the specimen of *nasus* departs farthest from the Lake Nipigon form which we are using as a standard. It is the longest-finned specimen examined (+22). In order of decreasing fin size, we have Peel River (+15), Yukon River (+11), Arctic Red River (+9); Baker Lake and Thelon River equal in fin length to Lake Nipigon specimens and the following with shorter fins,—Kittigasuit (−3), *kennicotti* (Alaska) (−9), Squanga Lake (−11), *nelsonii* (−19) and Lake Ontario with the shortest fins (−20). It is indoubtedly significant that the specimens from rivers have much longer fins than those from lakes.

The number of pyloric caeca is the most variable of all the characters investigated in the collections examined in connection with this study. Pyloric caeca numbers of five specimens from Arctic Red River were 146, 149, 153, 155 and 194; of five from Baker Lake 150, 171, 189, 194, 196; and of six from Hudson Bay 140, 152, 155, 170, 186, 222. Number

TABLE No. 4

LOCALITIES ARRANGED IN ORDER OF ASCENDING NUMBER OR SIZE OF A NUMBER OF BODY PARTS OF *Coregonus* FROM DIFFERENT LOCALITIES

Gill-rakers	Scales	Head length	Eye	Snout	Body depth	Caud. ped. L.	Dorsal fin
kennicotti	Baker Lake	*nasus*	Peel River	*nasus*	*kennicotti*	*nasus*	Lake Ontario
nelsonii	*nelsonii*	Arctic Red R.	Lake Ontario	Kittigasuit	Baker Lake	*kennicotti*	*nelsonii*
nasus	Lake Nipigon	Lake Ontario	Baker Lake	*kennicotti*	Yukon River	Kittigasuit	Squanga Lake.
Yukon River	Yukon River	Yukon River	*nasus*	Arctic Red R.	Lake Ontario	Yukon River	*kennicotti*
Kittigasuit	Peel River	*kennicotti*	Yukon River	Peel River	*nelsonii*	Peel River	Kittigasuit
Peel River	Arctic Red R.	*nelsonii*	Arctic Red R.	*nelsonii*	Squanga Lake	Squanga Lake	Lake Nipigon
Arctic Red R.	Lake Ontario	Kittigasuit	*nelsonii*	Squanga Lake	Arctic Red R.	*nelsonii*	Baker Lake
Baker Lake	Kittigasuit	Baker Lake	Lake Nipigon	Lake Ontario	Lake Nipigon	Arctic Red R.	Arctic Red R.
Lake Nipigon	*kennicotti*	Squanga Lake	Kittigasuit	Baker Lake	Kittigasuit	Lake Ontario	Yukon River
Lake Ontario	Squanga Lake	Peel River	Squanga Lake	Yukon River	Peel River	Baker Lake	Peel River
Squanga Lake	*nasus*	Lake Nipigon	*kennicotti*	Lake Nipigon	*nasus*	Lake Nipigon	*nasus*

of pyloric caeca would therefore appear to be of little value in the recognition of species.

There are no differences of the sort which characterize species between any of the northwestern whitefish or between any of them and Great Lakes whitefish. In an effort to indicate the nature and extent of the differences between the populations we have been considering, table 4 has been constructed. For each character,—gill-rakers, scale number, head length, etc.,—the collections have been listed in order of size, with the one having the lowest number or measurement at the top and the one with the highest at the bottom. This table does not indicate among northwestern whitefish any correlation of characters such as occurs in one species as compared with another. (See discussion of differences characterizing *Leucichthys pusillus* as compared with *L. laurettae*).

Table 5 indicates in the first column the number of times a certain collection appears at the top or bottom of a list in table 4. A place at the top or bottom of such a list indicates an extreme variation of the character in question as compared with the other collections considered.

TABLE No. 5

THE EXTENT OF DIVERGENCE BETWEEN *Coregonus* FROM DIFFERENT LOCALITIES
Number of times in Table 4 whitefish from localities indicated are:

At top or bottom of list	
kennicotti	3
nelsonii	0
nasus	6
Yukon River	0
Kittigasuit	0
Peel River	1
Arctic Red River	0
Baker Lake	1
Lake Nipigon	3
Lake Ontario	1
Squanga Lake	1

Next to *nasus*	
kennicotti	1
nelsonii	1
Yukon River	2
Kittigasuit	1
Peel River	2
Arctic Red River	1
Baker River	1
Lake Nipigon	0
Lake Ontario	0
Squanga Lake	1

There are eight lists, so that eight is the maximum number of times a collection could appear at the top or bottom. The fact that *nasus* appears in such a position six times whereas no other collection appears there more than three times indicates that *nasus* diverges more widely from the others than any of the others do from one another. In the second column of table 5 the number of times a collection appears next to *nasus* in table 4 is indicated. It is believed to be significant that the Peel and Yukon River collections were nearest to *nasus* in two characters each, while Lake Nipigon and Lake Ontario specimens are never next to it. Although the Kittigasuit specimens are in only one character next to *nasus*, they are only once removed in three other cases—in one of these cases *kennicotti* is interposed, and in the other two Peel River and Yukon River collections. In view of the fact that only two complete specimens from Kittigasuit were available, some of the differences between them and the other collections are probably not significant. On the basis of the characters here discussed, the specimens of *kennicotti* and the collections from the Peel and Yukon Rivers and from Kittigasuit approach *nasus* more closely than do the specimens of *nelsonii* or the collections from Arctic Red River, Baker Lake and Squanga Lake, while the Lake Nipigon and Lake Ontario collections are the most widely divergent.

A study of table 4 also shows the lack of a geographical trend in most of the characters considered. Gill-raker number is the only character in which any approach to a geographical trend is apparent. The possession by Squanga Lake specimens of the highest number of gill-rakers is the only departure from what is essentially a northwest-southeast trend in increasing number of gill-rakers. The question naturally arises as to whether the variation in some or all of the other characters may not be due to the effect of ecological conditions. It has already been noted that the collections from rivers all have longer fins than those from lakes. In Lake Nipigon (Dymond 1926) it was found that the eyes of all species of *Leucichthys* (5) found in Ombabika Bay were larger than those of corresponding species found in the lake proper. This condition is probably related to the slightly turbid conditions of the water of the bay.

COREGONUS NASUS, C. ODONOGHUEI AND *C. ATIKAMEG*

The wide variation in body proportions exhibited by whitefish from different ecological conditions misled Bajkov (1927, 1930, 1933) into the recognition in Western Canada of a number of distinct species: *nasus, odonoghuei, atikameg* and *atikameg manitobensis.*

In 1927 Bajkov recorded *nasus* from Beauvert Lake in the Athabasca River system, a tributary of the Mackenzie. His specimen has not been available for study and it is difficult to translate his measurements into the proportionate measurements used in this paper since he does not give the standard length of the specimen. In any case, his specimen was an unusually large one.

Through the kindness of Dr. D. S. Rawson of the University of Saskatchewan, I have had the opportunity of examining a specimen of Beauvert Lake *Coregonus*. Following are the proportionate measurements and counts for this specimen. The measurements of Lake Nipigon specimens of corresponding length are given in parentheses,—standard length 44 cm., scales 76, gill-rakers 26, branchiostegals 9, head length

191 (210), eye 38 (39), snout 53 (59), interorbital 59 (59), maxillary 54 (65), body depth 275 (300), body width 152, caudal peduncle length 98 (127), caudal peduncle depth 93 (86), dorsal rays 14, height 170 (168), base 141, anal rays 14, height 125 (124), base 136, pectoral length 188 (203), ventral 173 (178), adipose 73.

While in two of the eight characters considered in table 4 this Beauvert Lake specimen diverges more widely than *nasus* from the other collections included in the table, in a number of others it departs widely from *nasus*. For instance, it has a lower number of scales than any of those included, whereas *nasus* has the largest number. In number of gill-rakers, perhaps the most significant character for taxonomic purposes, it stands between the Baker Lake collection and those from the Great Lakes, and diverges from *nasus* more than any of the other northwestern populations except that from Squanga Lake. Unless all the collections here considered are regarded as variants of *nasus*, the Beauvert Lake whitefish cannot be considered as belonging to that species. Berg (1932, 1936) has already pointed out that the specimen described by Bajkov had more gill-rakers and fewer scales than typical *nasus* and proposed that it be regarded as a subspecies *canadensis*. The question of recognizing subspecies in *Coregonus* will be discussed later.

Coregonus odonoghuei from Clear Lake, Riding Mountains, according to Bajkov (1930), differs from *clupeaformis* "in the more slender body, longer caudal peduncle, larger head and the presence of many black spots on the fins and scales." The depth of the body he gives as 4.5 in length as against only 3.2 in *clupeaformis*. He apparently overlooks the fact that length of body to him is to the end of the caudal rays, whereas American workers have usually made their calculations on the basis of standard length. Recalculations of depth to standard length of the ten specimens for which Bajkov gives measurements yield the following proportions: .224, .289, .262, .261, .250, .240, .238, .246, .246, .243, average .250; average standard length 345. To arrive at these proportions standard lengths have been calculated from comparisons of standard length and total length of specimens from other localities and may not be entirely accurate for Clear Lake fish.

The depth of Lake Nipigon whitefish of the same average length as the above ten Clear Lake fish is 270. The difference is therefore −20. By reference to table 3, it will be seen that several populations of northwest whitefish have even more slender bodies than have Clear Lake whitefish.

The gill-rakers of *odonoghuei* according to Bajkov number from 24 to 29, average 26.2. Attention has already been drawn to the fact that there is a gradation in gill-raker counts from the Great Lakes northwestward. These Clear Lake specimens fit perfectly into this graded series. The scales of Bajkov's specimens ranged from 75 to 85 in the lateral line, average 79.9. For the Great Lakes, Koelz (1929) gives the following: Lake Nipigon 78-85, Superior 81-86, Huron 80-88, Erie 77-86, Ontario 80-88.

It appears obvious from a consideration of the above facts that *odonoghuei* is merely one of the numerous ecological forms of *clupeaformis*.

C. atikameg, Bajkov said, was "an anadromous species from Hudson Bay . . . . Very abundant along the shores of Hudson's Bay. In August it begins to ascend the rivers for spawning". It was said to differ from *clupeaformis* in its slender body and very dark colour . . . head, eye and adipose fin, very much larger . . . pectoral fins very long . . . caudal peduncle short, head flat dorsally, snout long and obliquely cut down backwards, maxillary long and nearly reaching the eye, the circum-orbital bones were said to be seven instead of usually six in *clupeaformis*. The gill-rakers were indicated as averaging 25.6 and lateral line scales 83.

C. atikameg manitobensis, Bajkov described as "a freshwater form of the above-mentioned fish . . . very abundant in all deep lakes of northern Manitoba, north of the Pas . . . also in the Nelson and Churchill rivers and probably in all other rivers north of Churchill in the Northwest Territories". Its colour, shape and proportionate measurements were said to be "very similar to the anadromous form". Its gill-rakers were given as 25.6 and scales as 76.3. How to distinguish the subspecies *manitobensis* from the typical form when both were in freshwater was not stated. It is hardly necessary to say that colour is influenced by the character of the waters in which fish live. In Black Sturgeon Lake near Lake Nipigon I have seen whitefish almost jet black (Dymond 1926, pp. 10-11). The formalin in which Black Sturgeon Lake specimens were preserved was quite dark-coloured after they had been in it a few days. The water of this lake is of a very dark brown colour.

The present author (Dymond, 1933) has already discussed the relationship of the *Coregonus* of Hudson and James Bays to that of the Great Lakes and decided that they represent the same species. The following comparison of body measurements of specimens from Hudson Bay and Lake Nipigon are quoted from the previous publication.

	Head	*Body*	*Caudal peduncle*		*Pectoral fin*
		depth	*length*	*depth*	*length*
Hudson Bay....	21.4	25.7	11.7	8.9	17.4
Lake Nipigon...	21.4	26.3	12.2	8.4	18.4

Scales were found to be 74-82 in Hudson Bay as compared with 78-85 in Lake Nipigon and 80-88 in Lake Ontario.

C. atikameg is undoubtedly synonymous with *clupeaformis*.

SUBSPECIES IN *COREGONUS*

Coregonus varies from one locality to another in all its body proportions and in such characters as number of gill-rakers, scales, branchiostegals and fin rays. Most of these characters, however, appear to show ecological rather than geographical variation. We have seen that the nearest approach to a geographical cline (Huxley 1938, 1939) is found in number of gill-rakers. There is a rather gradual decrease in number of gill-rakers from the Great Lakes northwestward to the Mackenzie River and perhaps beyond. On the basis of such differences, we might regard the whitefish of the Mackenzie River region as constituting a subspecies for which the name *kennicotti* is available. In his description of this form Bean mentioned, although he did not emphasize, its small gill-raker count. There is more evidence than that included in the present paper that whitefish of the Hudson Bay drainage have a characteristic gill-raker range intermediate between Great Lakes and northwestern whitefish. On the basis of such data, three subspecies might be recognized: *clupeaformis*, *hudsonius* and *kennicotti*. Complications would arise, however, when one tried to name on this basis the Squanga Lake whitefish which as we have seen have a gill-raker number characteristic of the Great Lakes. It would be more logical to regard this population as a fourth subspecies than to lump it with the Great Lakes form. It is unlikely that Squanga Lake is the only population differing markedly from those in its general area, so that we should ultimately have to recognize a very large number of subspecies, many of them with a sort of crazy-quilt pattern of distribution. Koelz (1931) recognizes among *Coregonus* from 36 lakes of northeastern America from which he had specimens, six subspecies other than typical *clupeaformis*. On the same ratio, it would probably be possible to erect several hundreds, if not several thousands, of subspecies of North American *Coregonus*, for there are undoubtedly many thousands of lakes across northern Canada containing whitefish. There probably exist whitefish exhibiting almost every possible combination and permutation of characters which vary with the environment. Until some relationship has been worked out between environmental factors and body characters of *Coregonus*, the description of subspecies on the basis of the characters of individual local populations adds to confusion rather than to enlightenment.

RELATIONSHIP OF AMERICAN AND ASIATIC WHITEFISH

There is still the question as to the relationship between the American and Asiatic whitefish. It has been shown that in gill-raker count, perhaps the most satisfactory character on which to base taxonomic distinctions, *nasus*, one of the Siberian whitefishes, represents a continuation westward of a fairly smooth trend from the Great Lakes northwestward. On the basis of this character alone, one would scarcely be justified in drawing a hard and fast line between Asiatic and American whitefish. However, *nasus* is practically, if not actually, at one end of the series in gill-raker count and at the other end in number of scales. In a number of its body proportions it differs widely from most American forms, although occasional populations, as for example the Beauvert Lake form, are even more extreme than *nasus* in such characters as body depth and caudal peduncle length. It is obvious therefore that *clupeaformis* is the American representative of *nasus*. It would probably be as logical to regard *clupeaformis* as a subspecies of *nasus* as it is to regard *quadrilateralis* as a subspecies of the Asiatic round whitefish *cylindraceus* as proposed by Berg (1936).

However, in the writer's opinion it is premature to adopt the name *nasus* for the common whitefish of America. The *Coregonus* type is spread throughout the northern part of the northern hemisphere from Ireland to the Maritime Provinces of Canada. Within this wide range, it appears in numerous forms, the taxonomic relationships of which we are still far from understanding. Smitt, as long ago as 1893 drew attention to "the peculiarities which seem to characterize the Gwyniad (the European whitefish) where it lives under exceptional conditions.... However unlike the differentiation of form may be in localities at a distance from each other, variations as great may be observed in the same water, the extremes of the form-series appearing side by side. No wonder then that ichthyologists have failed sharply to define local varieties, though a more than adequate number of names have been proposed to this end". He concludes his discussion, which includes a consideration of *Coregonus* in Asia, with the remark that "we know of no specific difference between *C. clupeaformis* and our European Gwyniad". Until a more adequate understanding of the relationship of the various forms of *Coregonus* is arrived at, I suggest that *clupeaformis* be retained as the name of the American representative.

According to Dall (1870, 1871) and Bean (1884) the Alaskan whitefish, to which the name *kennicotti* was later applied, i.e., the so-called broad whitefish, was in the early days of American possession of Alaska referred to as the muksun. Muksun is the common and also the specific name of one of the species of *Coregonus* occurring in Siberia. Berg (1932) gives its occurrence as "From freshwater parts of the Arctic Ocean it enters rivers from the Pechora to Kolima. More common in the lower courses of the rivers". Its gill-rakers, which are said to number 44 to 65, are much more numerous than those of any American *Coregonus*. Its resemblance to our forms must be largely superficial.

HABITS AND ECONOMICS

For the following information on the habits and economics of the whitefish of the lower Mackenzie area I am indebted to Mr. K. H. Lang, who has spent many years in that region.

In that area whitefish make up a large part of the food of the people and of their sledge dogs; they are preferred to all other species. They occasionally exceed twenty pounds in weight although ten pounds is usually considered a very large fish. Four to five pounds is the average size.

It is found in most of the channels and lakes of the delta region. Some are taken in quite brackish water along the coast north at Tuktuyaktok (Port Brabant) although not in great numbers. They are caught in nets set in the back eddy of the river channels and in narrows between lakes; four and a half and five inch mesh are generally used.

In winter they are caught in nets set under the ice and just piled up and frozen. In summer some are put in pits in the ground for dog food. If the pits are deep and the flies kept out, they make excellent dog food. Such fish, when frozen, are often eaten by the Eskimos too and considered by them as quite a delicacy. Mr. Lang says they once told him it tastes "all same sardines". Sardines are "white man ippy fish" in Eskimo. With reference to the fish preserved in pits Mr. Lang remarks: "I can't vouch for the taste but, believe me, they don't smell like sardines." In summer great numbers of fish are also dried and smoked for use in winter as food for both humans and dogs. The head and entrails are removed and the backbone cut loose from the flesh. The fish is then scored with a knife so that it will dry in the sun in three or four days. After being smoked for about 48 hours, they are ready to bale up. A four or five pound fish will then weigh about a pound.

As an example of fishing in this area, Mr. Lang cites his experience at his camp 3 on the East Branch during the summer of 1936. From July 10 to August 15 he caught approximately 5000 fish, of which 83 per cent were whitefish, the other 17 per cent being pike, inconnus and crooked-back whitefish in about equal numbers. The fish did not start running strongly until about July 18, but after that date the run was steady. In three nets from 180 to 220 were caught each day—all that could be dressed for drying. The fish travelled upstream at the rate of four miles a day. The rate was determined by comparing notes with fishermen downstream. This run occurs every year.

At this season, the fish are quite fat and full of maturing ova. The largest fish caught that year was 13 pounds; smaller than the record fish in most years. The fish were brightly coloured, showing that they had recently come from some clear water lake. The river water is turbid, and fish soon become dull and pale after spending some time in it. After about six weeks, this yearly run slackens and fish are not caught in numbers again until after freeze-up when a short run occurs under the ice.

PROSOPIUM

PROSOPIUM CYLINDRACEUM

Round whitefish are widely distributed in northern Asia and northern North America from the Yenisei River in Siberia to New Brunswick and Maine. The common North American form has been known under the specific name *quadrilateralis* since 1823 when Richardson described under that name specimens from "small rivers about Fort Enterprise and the Arctic Sea". The Siberian species is known as *cylindraceus*. Recently Berg (1936) has suggested that the Asiatic and American forms are so similar as to be properly regarded as of the same species. He says "according to Koelz (1927) the number of scales in the lateral line in numerous specimens from the Great Lakes and Lake Nipigon is (74) 84 to 95 (100) and the number of gill-rakers is usually 16 to 18; both averaging somewhat fewer than in typical *cylindraceus*. So far as known these are the only differences between *cylindraceus* and *quadrilateralis*." Berg gives the lateral line scales of *cylindraceus* as 89-106, average 96, and gill-rakers as usually 18 to 20.

In comparing *quadrilateralis* and *cylindraceus*, it will be noticed that Berg takes Great Lakes and Lake Nipigon specimens as representing *quadrilateralis*, whereas this name properly belongs to a Northwest Territory form. Efforts to secure specimens from the type locality have been unsuccessful. There is no longer any settlement at the site of Fort Enterprise.

Table 6 gives proportionate measurements and counts of gill-rakers, scales, fin rays, etc. of specimens from the general area of the type locality. For comparison, similar measurements and counts for Lake Ontario specimens are also included.

It will be noticed that northwest specimens have more scales and gill-rakers than Lake Ontario specimens. Altogether, 14 specimens from the northwest were examined. These fourteen average 92.6 scales (86-100) and 18.1 (16-20) gill-rakers. Koeltz (1929) gives actual counts for 32

TABLE No. 6

PROPORTIONATE MEASUREMENTS AND COUNTS OF BODY PARTS OF *Prosopium cylindraceum* FROM DIFFERENT LOCALITIES

Number of specimens	Great Bear Lake 4		Rutledge River‡ 3		Baker Lake 5		Baker Lake No. 10781	Yukon River 1	Lake Ontario 10	Churchill No. 7342 ♂	Hudson Bay No. 7343 ♀
	Average	*Range*	*Average*	*Range*	*Average*	*Range*					
Standard Length	316	300-330	421	400-437	345	325-379	283	315	322	395	292
Scales	95	90-100	92	89-97	92	86-99	92	90	86	87	89
Gill-rakers	18.8	18- 19	19	18- 20	17	16- 18	18	18	17.2	16	18
Branchiostegals	8	8	6.7	6- 7	6.6	6- 7	8	8	7.3	7	7
Pyloric caeca	100.8	82-116	91	81-102	90.4	76-105	74	104	84.3†		
Head length	184	177-195	204	202-206	182	180-185	154	184	188	203	195
Head depth	121	115-124	136	129-140	116	114-119	125	121	121	133	126
Eye	37	35- 38	40	39- 41	36.6	36- 37	40	38	44	41	43
Snout	50	46- 53	58	56- 61	47.6	45- 50	47	48	49	53	47
Interorbital	56	52- 62	70	68- 71	54	52- 55	53	54	57	63	55
Maxillary	43	38- 46	47.7	47- 48	43	39- 48	47	42	42	51	42
Body depth	206	182-221	230	213-240	210	200-221	179	222	204	161	188
Body width	144	133-154	155	148-165	138	129-146	144	159	127	101	120
Caudal peduncle											
Length	149	136-178	124	118-133	148	133-161	151	152	145	140	137
Depth	77	76- 78	87	85- 88	72	69- 80	74	73	70	84	76
Dorsal rays	13.5	13- 14	13	13	13.4	13- 14	14	13	13.4	13	12
Dorsal height	145	138-153	167	160-173	132	124-137	133	143	141	146	154
Dorsal base	127	122-132	120	114-129	116	108-137	120	124	108	116	119
Anal rays	12.5	12- 13	12.3	12- 13	12.4	12- 13	13	13	11	11	11
Anal height	119	114-123	136	132-141	110	101-114	107	124	101	134	135
Anal base	93	87- 97	93	87- 98	88	85- 94	92	94	75	94	86
Pectoral length	154	145-167	186	183-191	155	151-158	154	149	154	153*	164
Ventral length	139	132-145	162	153-167	133	126-149	130	133	132	143	147
Adipose length	70	61- 75	68	61- 73	61	58- 65	70	84	61	62	75

*Decidedly falcate.
†Range 50-102.
‡Tributary to Great Slave Lake via Taltson River.

specimens from the Great Lakes. These average 89 (74-97) scales and 17.1 (15-19) gill-rakers. These results indicate that northwest specimens in number of scales and gill-rakers approach *cylindraceus* more closely than do Great Lakes specimens. In respect of these characters the forms under consideration appear to represent a cline (Huxley 1938, 1939). Their separation into a Siberian and a North American subspecies would appear to be merely arbitrary. Berg's reference to a single specimen from the Anadyr River having 86-88 scales and 18 gill-rakers indicates that even in Asia a trend towards lowered scale and gill-raker counts occurs. In America the trend towards lowered scale and gill-raker counts appears to be continued eastward beyond the Great Lakes. Three specimens from the Restigouche River, New Brunswick, average 87 scales and 16.3 gill-rakers.

Prosopium is subject to considerable variation from one locality to another even in the same region. This is especially evident in body form and length of fins as is shown by a comparison of the specimens from Fort Smith with those from Great Bear Lake. The Fort Smith specimens have considerably longer, deeper and wider heads, deeper and wider bodies, shorter and deeper caudal peduncles and longer fins. It should be noted however, that the Fort Smith specimens are much larger than those from Great Bear Lake. Two specimens from Churchill, Hudson Bay, (Table 6) varied widely from the usual type. They were long, slender and compressed with overhanging snouts. The smallest of the five specimens from Baker Lake, listed separately in table 6, No. 10781, had a much shorter but deeper head and a more slender body than the others. All of these abnormal specimens, however, had the usual number of scales and gill-rakers. It is probable that *Prosopium* is even more subject to environmental modification than *Coregonus* or *Leucichthys*. The occurrence in a number of collections of one or more specimens of deeper and more compressed form with shorter caudal peduncle may have more than ecological significance but the present collection is not large enough to warrant any conclusion in this connection.

Berg (1932) refers to Borisov's observations on the differences between the *Prosopium* of the upper and of the lower part of the Lena River in Siberia. Those from the lower Lena have a less deep body, 15.9% of the length to the end of the middle rays of the caudal, as compared with 16.7% in the case of those from the upper Lena. Lower Lena specimens also have wider heads and shorter snouts. Specimens from the upper Lena are said to have a more rapid growth rate than those from the lower Lena.

The specimen described by Harper and Nichols (1919) under the name *preblei* appears to have been a typical representative of *cylindraceum*. The type specimen of *preblei* could not be located in the National Museum of Canada, where it is said to have been stored. The similarity of this specimen to those included in table 6 is shown by the following proportionate measurements derived from Harper and Nichols's description. Standard length 470, scales 93, gill-rakers 17, branchiostegals 8, head length 187, eye 32 (the deviation in this character is undoubtedly due to a different method in making the measurement. This opinion is confirmed by a re-measurement of the three specimens of *Leucichthys* described in the same paper, which were available for measurement); snout 55, interorbital 60, maxillary 47, body depth 213, 14 developed dorsal rays, dorsal height 138, 11 developed anal rays, anal height 128, anal base 94, pectoral length 153, ventral length 130.

A comparison of *quadrilaterale* and *williamsoni* has been made by Dymond (1936).

PROSOPIUM OREGONIUM

Six specimens from Lesser Slave Lake, Alberta, appear to belong to the species *oregonium* described by Jordan and Snyder (1909) from the McKenzie River, Oregon.

Proportionate measurements and counts of body parts of these six specimens and of the type which I was privileged to measure in the United States National Museum are given in table 7. There is considerable difference in body proportions between the Lesser Slave Lake specimens and the type. The type of *oregonium* has a longer and wider head with correspondingly longer snout and maxillary, more compressed and slender body and more slender caudal peduncle. It has also a much larger adipose, one of the characters which distinguishes *oregonium*. While the adipose of the Lesser Slave Lake specimens is not as large as that of the type of *oregonium*, it is very much larger than that of any *cylindraceum* included in table 6.

In view of the wide variation in body proportions shown by *Prosopium* as cited in the discussion of *quadrilaterale* above, the variation from the type of *oregonium* shown by the Lesser Slave Lake specimens is not considered to indicate that they belong to a different species, especially in view of the similarity in gill-raker number, the most stable coregonine character. As pointed out in the discussion of *Coregonus*, until the effect of various ecological factors on the morphometry of coregonines has been worked out, it adds to confusion rather than to elucidation to multiply species and subspecies.

TABLE No. 7

PROPORTIONATE MEASUREMENTS AND COUNTS OF BODY PARTS OF *Prosopium oregonium* FROM LESSER SLAVE LAKE, ALBERTA AND OF THE TYPE No. 62987, U.S. NAT. MUSEUM

	13248	13249	3346	13251	13250	13252	TYPE
Length length.....	377	353	340	324	321	244	405
Scales............	88	84	77	83	81	82	90
Gill-rakers........	22	22	23	24	22	22	22*
Branchiostegals....	8	8	8	8	8	9	9
Pyloric caeca......	102	95	118	82	96		
Head length......	211	214	209	221	206	211	259
Head depth.......	149	147	150	154	151	137	153
Eye..............	40	41	47	46	44	47	40
Snout............	72	68	62	77	59	59	97
Interorbital.......	63	61	47	66	62	47	69
Maxillary.........	63	61	58	69	53	53	84
Body depth.......	295	255	268	250	280	205	200
Body width.......	194	166	150	204	193	129	107
Caudal peduncle							
Length.........	115	119	135	122	143	125	136
Depth..........	84	82	82	89	88	78	67
Dorsal rays.......	14	14	14	14	14	15	15
Dorsal height.....	152	169	168	154	162	166	
Dorsal base.......	135	127	128	133	140	135	
Anal rays.........	13	12	12	13	14	13	15
Anal height.......	143	146	150	149	147	143	
Anal base.........	105	105	99	100	101	102	
Pectoral length....	170	170	187	173	178	178	182
Ventral length.....	152	157	174	157	156	156	170
Adipose length....	97	102	97	113	107	111	137
Sex..............	female	female	female	male	female		

*The gill arch was not removed, but so far as could be determined without removing the arch, there were 22 gill-rakers

PROSOPIUM COULTERII

Prosopium coulterii described by Eigenmann and Eigenmann (1892) from the Kicking Hose River at Field, British Columbia, and recorded (Eigenmann 1895) also from Golden, British Columbia, has not been reported from the Northwest Territories or Yukon, although its range has been extended to include both Washington and Alaska. Jordan and Snyder (1909) record it from Diamond Lake, Stevens County, Washington, and Kendall (1917; 1921) from two localities in Alaska,—Second Lake and the stream connecting it with First Lake, presumably near Chignik, and Lake Aleknagik. In his 1921 paper Kendall suggests that this species may have been comprised in other collections and confused with the round whitefish. He believes, for instance, that the figure of the head of *Coregonus quadrilateralis* from Port Halkett shown by

Günther (1866 p. 176) may be *coulterii.* Incidentally he remarks that there are two Port Halketts, one in British Columbia and one at the mouth of the Mackenzie River.

Following is a description based on measurements of one of Eigenmann's specimens which I made in the British Museum (Natural History). Proportions indicated as percentages of the standard length, which in the case of this specimen was 155 mm. Head length 21.3, eye diameter 5.8, snout 5.2, interorbital width 6.5, maxillary 6.0, dorsal rays 9, dorsal height 19.0, dorsal base 11.0, anal rays 10, anal height 18.4, anal base 10.0, pectoral length 20.3, ventral length 18.7, adipose length 8.1, scales 59.

LEUCICHTHYS

In contrast to the condition in *Coregonus* and *Prosopium* in which no body of water appears to have more than a single species of each genus, two or more species of *Leucichthys* commonly occur together. Koelz (1929) recognizes seven species of this genus in Lake Huron. When combined with this condition we have the intraspecific variation from one body of water to another, it is to be expected that the number of species that have been described is greater in *Leucichthys* than in either *Coregonus* or *Prosopium.*

In his 1823 account of the fishes of northwestern Canada, Richardson doubtfully identified the lake herrings met with as *artedi.* He said they were found in most of the lakes and that he had caught a few in the sea at the mouth of the Coppermine River. In his 1836 account, he designated the lake herring which he found so abundant in Great Bear Lake as *Salmo* (*Coregonus*) *lucidus.*

That the lake herrings found in and about the mouths of the rivers of Alaska and northwestern Canada have long been recognized as belonging to two species is mentioned below in comparing *laurettae* and *pusillus.* These names were given to these two species by Bean in 1882 and 1889 respectively.

Scofield in 1899 gave the name *alascanus* to three specimens taken in northern Alaska, one in salt water at Point Hope and two in brackish water at Grantley Harbour. They were, he said, nearest related to *artedi* but differed considerable in number of gill-rakers.

Harper and Nichols (1919) gave the names *entomophagus*, *athabascae* and *macrognathus* to lake herrings found in the Tazin River, Lake Athabaska and Great Slave Lake respectively.

The type of *lucidus* is not in existence and I have been unable to locate the type of *alascanus.* It is not in the United States National Museum nor in the Natural History Museum of Stanford University.

I have examined the types of all the other species mentioned above,—*laurettae* and *pusillus* in the United States National Museum, and *entomophagus*, *athabascae* and *macrognathus* in the National Museum of Canada. In addition I have examined 54 specimens from northwestern Canada, as already listed.

LEUCICHTHYS LAURETTAE and *L. PUSILLUS*

The lake herrings of the Mackenzie delta, so far as the collections which I have examined are concerned, belong to two species which I identify as *laurettae* and *pusillus*.

Table 8 presents the proportionate measurements of the type specimens, as well as those of collections from various places in the Mackenzie region. It will be noticed that *pusillus*, as compared with *laurettae*, has fewer scales, more gill-rakers, shorter and less deep head (comparing specimens of equal size), larger eye, narrower interorbital, longer maxillary, deeper and more compressed body, longer fins, longer anal base (correlated with more anal rays) and fewer branchiostegals (*pusillus* usually has 8 branchiostegals whereas *laurettae* usually has 9). The most striking difference between the two species is in the size of eye; within the size range investigated *pusillus* has an eye with a proportionate measurement of more than 50, *laurettae* of less than 50. *pusillus* does not reach as large a size as *laurettae*. The small size of *pusillus* is mentioned by Bean in his original description. The largest individual he had seen was 11½ inches long. The largest individual in our collection is 288 mm. in standard length or 321 mm. (12 5/8 in.) to fork of tail. Our largest specimen of *laurettae*, a skin, is approximately 430 mm. in standard length or 460 mm. (18 1/8 in.) to fork of tail.

Additional characters distinguishing the two species are the almost vertical premaxillaries of most specimens of *laurettae*; the lower jaw is equal to or shorter than the upper. The premaxillaries of *pusillus* on the other hand are disposed at a wide angle to the vertical and the lower jaw is usually longer than the upper; the whole head is wedge-shaped, the upper and lower profiles straight and meeting at a sharp angle at the snout.

The fins of *pusillus* are darker, especially towards their distal ends, the ventral fins often quite black, those of *laurettae* light-coloured. The dark colour of the dorsal fin of *pusillus* is mentioned by Scofield (1899) as follows: "One of the specimens from the mouth of the Mackenzie is the only one that shows perfectly the black markings on the dorsal as given in the figure of a similar sea-run individual from northern Alaska (Whitefishes of America. Report of U.S. Commissioner of Fish and

TABLE No. 8

PROPORTIONATE MEASUREMENTS AND COUNTS OF BODY PARTS OF *Leucichthys*

Species	*pusillus*	*pusillus*		*laurettae*		*laurettae*		*laurettae*	
Specimens	Type USNM 38366	15[1]	Range	Type USNM 27695[3]	Range	5[5]	Range	6[7]	Range
Standard length	250	261	227-288	323	305-335	309	283-326	354	330-370
Scales	88	80	74- 84	85.5	80- 93	92[6]	84- 99	91	88- 93
Gill-rakers	49	45.5	42- 48	37	33- 43	42[6]	39- 46	43.6	40- 50
Branchiostegals	8	8	7- 9[2]	9.5	8- 10[4]	8.8[6]	8- 9	8.8	8- 9[8]
Head length	200	200	186-215	202	188-213	214	198-222	201	194-211
Head depth	134	129	116-139	133	125-140	147	129-177	135	126-142
Eye	56	55	51- 59	43	42- 46	45	42- 47	44	41- 46
Snout	50	48	43- 55	47	45- 49	50	47- 55	47	44- 48
Interorbital	54	47	43- 53	58	57- 59	59	55- 61	61	58- 63
Maxillary	68	74	69- 79	66	63- 69	69	63- 72	66	64- 72
Body depth	212	229	192-263	235	209-252	218	192-243	224	213-232
Body width	104	120	112-142	126	121-130	139	113-153	124	117-130
Caudal peduncle									
Length	120	120	106-142	123	110-139	124	108-129	120	112-131
Depth	80	81	73- 89	76	73- 82	77	69- 83	73	68- 77
Dorsal rays	12	12.4	12- 13	13.8	13- 15	13.8	13- 14	13.2	13- 14
Dorsal height	148	191	174-213	137	130-146	149	129-173	137	128-142
Dorsal base		116	96-128			131	126-141	123	119-127
Anal rays	14	14.5	13- 16	13.7	13- 14	13	12- 14	13.7	13- 14
Anal height		121	113-131	96	86-107	99	85-109	96	92-102
Anal base		133	120-155	115	104-128	106	98-114	111	103-119
Pectoral length	152	182	164-199	142	131-151	152	131-176	144	131-151
Ventral length	140	177	162-191	135	131-141	140	114-160	139	127-151
Adipose length	76	67	57- 75	60	58- 63	72	59- 77	73	67- 80

[1] 5 from Kidluit, 8 from Whitefish Stations and 2 from Tuktuyaktok (Port Brabant).

[2] 13 had 8, 1 had 7 and 1 had 9.

[3] 4 specimens with the same number, distinguished as A. B. C. D.

[4] 3 had 10, 1 had 8.

[5] 3 from Kidluit, 1 from Kittigasuit and 1 from Peel River.

[6] 10 skins (8 from Whitefish Station and 1 each from Kidluit and Kittigasuit) had an average of 87 scales, 42 gill-rakers and 8.4 branchiostegals.

[7] Arctic Red River.

[8] 5 had 9, 1 had 8.

Fisheries, 1894. Plate 23; also same plate in Cruise of Steamer Corwin)." *L. pusillus* has the more compressed, *laurettae* the more terete body.

It will be noticed that there are considerable differences between the measurements of specimens from the Mackenzie region and those of the types especially in number of scales, fin lengths and in body depth and width of *pusillus*. We have already seen in the case of *Coregonus* that there is considerable variation in fin length between collections from different localities and that this character is probably correlated with ecological conditions. Body depth of the type is within the range shown by the 15 specimens from the Mackenzie region. The latter collection undoubtedly represents an ecological variation of *pusillus*.

That the lake herrings (*Leucichthys*) of the coastal areas of northwestern America were of two quite different sorts was recognized long before Bean gave them the names *laurettae* (1882b) and *pusillus* (1889). Dall (1870) distinguished them as sea whitefish and Nulato whitefish. His 1871 list stated that the Nulato whitefish "is a small, thin, bony species, common near Nulato, on the Yukon, and is rarely more than half a pound in weight. It is of little use as food, and is principally abundant in summer". The other species which he designated simply as whitefish is described as "the most abundant and best flavoured species of *Coregonus* in most localities . . . . It rarely exceeds three pounds in weight and is the staple article of food in winter on the Yukon".

Bean (1882c, 1884, 1885b) lists *laurettae* and *Merckii* var. or "the species related to C. Merkii" as the members of this group that occur in Alaskan and adjacent waters. The latter is the species to which he later (1889) gave the name *pusillus*. Dall's estimate of it as "a small, thin, bony species" has been repeated by most subsequent authors.

Anderson (1913) also refers to tullibees of two sorts. One is known to the Mackenzie Eskimos as Pi-kok-tok, the other as An-Ark'hlirk.

L. laurettae is called herring, fresh-water herring, lake herring and tullibee by Mr. Lang. It is a very common fish in the waters of the Mackenzie delta. It is well liked as human food and is equal to whitefish as dog food since it is fat most of the year. At Arctic Red River it is caught, dried and smoked in great numbers by the Indians every summer. In the fall it is caught at nearly all the fishing places. The reason it is not caught in greater numbers still is that it requires a special net, and since they are smaller than whitefish they do not bulk up so fast. It reaches a weight of 2½ to 3 pounds but the average is a pound or less.

L. pusillus is a much smaller and less valuable species. It was called "big-eye" by Mr. Lang. It occurs in the Peel River right up to Fort McPherson but does not appear to be plentiful in the delta.

RELATIONSHIP TO ASIATIC SPECIES

These two species, *pusillus* and *laurettae*, are undoubtedly closely related to *sardinella* and *autumnalis* respectively of Siberia.

Berg's key of sub-genus *Leucichthys* (p. 198-199) abbreviated is as follows:

A. Mouth superior, upper jaw shorter than lower, the lower sharply turned upwards; gill-rakers 36-54.
    B. Antedorsal distance more than 42% of body length to end of middle rays of caudal........ *albula*
    BB. Antedorsal distance less than 42% of body length to end of middle rays of caudal........ *sardinella*
AA. Mouth terminal, upper jaw either equal to or longer than lower but never shorter.
    C. Gill-rakers 25-31 (33)........................ *tugun*
    CC. Gill-rakers more than 33
        D. Gill-rakers 35-51........................ *autumnalis*
        DD. Gill-rakers 56-68........................ *peled*

L. albula is confined to Europe; *tugun* and *peled* have respectively fewer and more gill-rakers than either *pusillus* or *laurettae*. Among the synonyms of *sardinella*, Berg lists *merki* and *clupeoides*, and of *autumnalis*, *omul*.

Like *pusillus* and *laurettae*, *sardinella* and *autumnalis* occur in the mouths of Arctic rivers which they enter at spawning time. As already stated, Bean (1882c, 1884, 1885b) originally regarded the species to which he later gave the name *pusillus* as conspecific with *merki* (*sardinella*) and Berg (1932) describes *sardinella* as close to or identical with *pusillus*. As in *sardinella*, the lower jaw is usually longer than the upper.

Berg's (1932) descriptions do not include all of the details necessary to make a comparison of *sardinella* and *autumnalis* with *pusillus* and *laurettae*. The following comparisons indicate that *sardinella* as compared with *autumnalis* has fewer scales, more gill-rakers, and does not reach as large a size, which are parallel to differences in the same characters between *pusillus* and *laurettae*.

	sardinella	*autumnalis*
scales........................	71-97	86-111
gill-rakers......................	37-52	35-51 (aver. 45-46)
maximum length (to end middle rays of caudal)..............	415 mm.	615 mm.

The similarity of *autumnalis* to *laurettae* is indicated by the vertical disposition of the premaxillaries shown in Berg's illustration of the former (p. 212). When I examined a specimen of *omul* (*autumnalis*) from Lake Baikal, in the British Museum (Natural History), I noted "premaxillaries vertical as in *Coregonus* but not quite so high".

Berg gives the distribution of *sardinella* as "from the Ob to the Kolima, district of Chukotski peninsular and the Bering Sea; present in the Anadir; and *autumnalis* as "with the exception of the Ob, it enters from the sea into all the rivers which fall into the Arctic Ocean from the Mezen on the west to Chaun Bay (east of Kolima) on the east; Nova Zembla, Kolguev."

Moreover presumed hybrids similar to those regarded as crosses between *Stenodus* and *autumnalis* occur in the Delta region of the Mackenzie.

It seems certain, therefore, that *pusillus* and *laurettae* merely represent extensions eastward of *sardinella* and *autumnalis*. As these names are the older (*sardinella* 1848; *autumnalis* 1776), they should be recognized.

LEUCICHTHYS ALASCANUS

Although *L. alascanus* has not been recorded from Canadian waters, it should be discussed here since it is the only spcies of *Leucichthys* other than *pusillus* and *laurettae* described from the coasts of northwestern America.

As Jordan and Evermann (1911) suggest, this species, which is known only from the type localities, Point Hope and Grantley Harbour, Alaska, is probably identical with *laurettae*. The gill-raker numbers (33-37) and size of eye given by Scofield (1899) in his original description indicate its similarity to *laurettae*. Moreover he recorded *pusillus* but not *laurettae* from Grantley Harbour. In view of the fact that two and only two species of *Leucichthys* have been found in salt and brackish waters off the northern coasts of Asia and northwestern America, it seems certain that *alascanus* and *laurettae* are identical.

I have been unable to locate the type specimens, the only ones of the species ever reported.

LEUCICHTHYS LUCIDUS

The name *lucidus* has been almost entirely restricted to the lake herrings of Great Bear Lake. Only occasionally has the name been applied to other populations. For instance, Scofield (1899) identified two specimens taken in salt water off Herschel Island and Evermann and Goldsborough (1907b) specimens collected by Preble from Arctic Red River as of this species. Dymond (1936) reported that a specimen in the Provincial Museum of British Columbia had been provisionally identified as *L. lucidus*.

TABLE No. 9

PROPORTIONATE MEASUREMENTS AND COUNTS OF BODY PARTS OF *Leucichthys* FROM GREAT BEAR LAKE, AND BAKER LAKE

	Great Bear Lake		Baker Lake†	
	12*	Range	5*	Range
Standard length	283	229-340	311	274-360
Scales	81	75- 89	80	78- 85
Gill-rakers	45.6	42- 50	43.4	40- 46
Branchiostegals	8.3	8- 9	8.8	8- 9
Head length	218	206-236	209	199-217
Head depth	147	139-158	137	125-149
Eye	48	43- 57	45	41- 49
Snout	56	51- 61	54	50- 57
Interorbital	60	56- 69	58	56- 61
Maxillary	76	69- 83	71	69- 73
Body depth	260	224-297	221	197-237
Body width	147	138-164	139	131-155
Caudal peduncle				
Length	127	113-144	129	121-140
Depth	80	76- 88	76	66- 81
Dorsal rays	11.8	11- 13	12.6	11- 14
Dorsal height	151	130-166	144	131-157
Dorsal base	107	94-119	111	105-119
Anal rays	12.3	11- 13	12.8	12- 13
Anal height	98	86-110	93	85-100
Anal base	98	85-110	105	98-111
Pectoral length	158	146 177	149	134-156
Ventral length	151	135-164	152	141-161
Adipose length	56	44- 64	63	59- 67

*Number of specimens. †Including river between Beverley and Aberdeen Lakes.

Table 9 gives proportionate measurements and numbers of scales, gill-rakers, fin rays, etc. of 12 specimens from Great Bear Lake. A study of their characters as shown by this table indicates the similarity of *lucidus* to *artedi* as suggested by Gilbert (1895).

Each species of *Leucichthys* has a characteristic combination of characters as illustrated by the difference between *pusillus* and *laurettae*. The same species will show variation in a character such as length of head, size of eye, number of scales, etc. but from one locality to another the variation is usually not so great as to obscure the similarity as shown by the same *combination* of characters.

Figure 1 has been constructed to illustrate the relations between three characters—head length, height of dorsal fin and diameter of eye of the following populations:

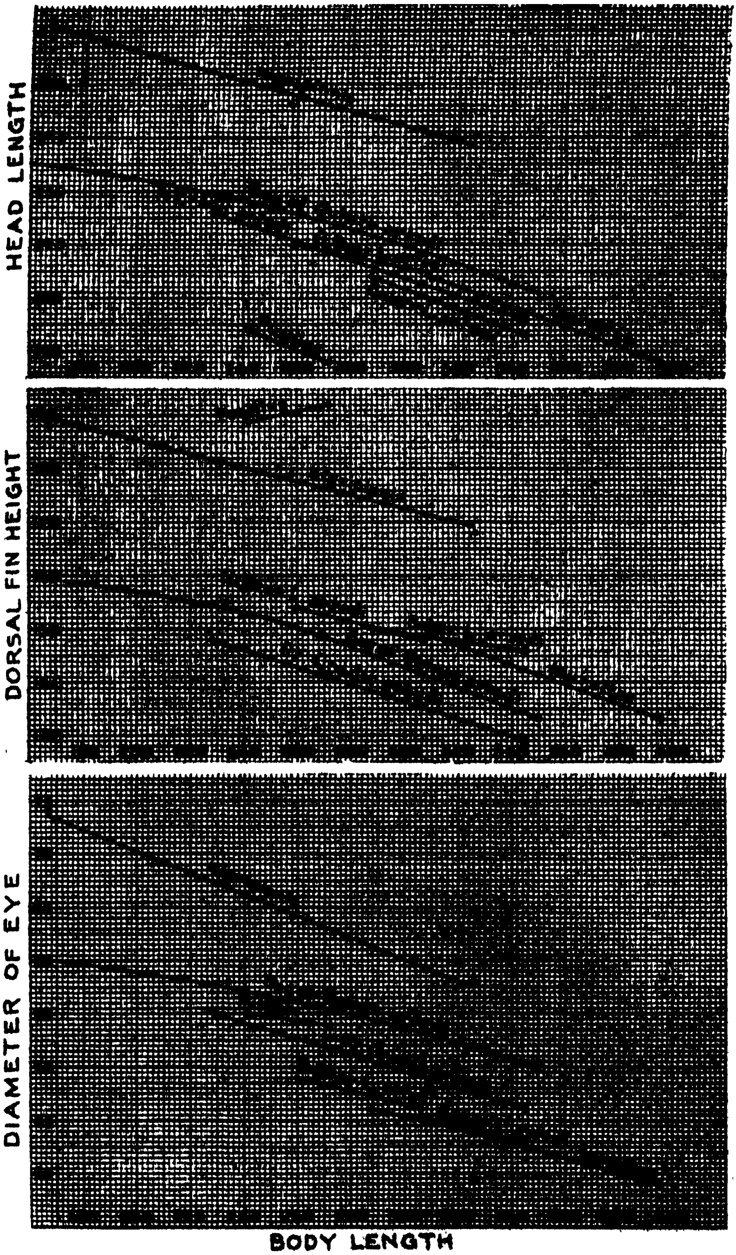

Fig. 1—Illustrating relations between head length, dorsal fin height and eye diameter of various populations of *artedi*, and of *laurettae*, *nigripinnis* and *pusillus*.

L. artedi from two localities in Lake Ontario—Port Credit and Bay of Quinte, as found by Pritchard (1931).

L. lucidus from Great Bear Lake.

Five specimens from Baker Lake and the river between Beverley and Aberdeen Lakes.

L. laurettae

By way of contrast with the above, the same three characters of *nigripinnis* from Lake Nipigon (Dymond, 1926) and of *pusillus* are included. The values on which the curves are based are as follows:

	Number of specimens	Average length	Head length	Dorsal fin height	Eye diameter
Port Credit					
artedi	27	229	226	148	55
	13	272	219	141	52
	7	345	206	129	46
Bay of Quinte					
artedi	20	132	238	160	61
	38	234	229	155	58
	20	268	225	149	55
	4	350	211	133	50
Great Bear Lake	6	260	220	154	49
	6	306	215	148	46
Baker Lake	3	288	214	150	46
	2	345	203	146	43
laurettae	5	309	214	149	45
	10	396	198	133	39
nigripinnis	3	166	261	189	74
	7	258	246	179	64
	13	326	240	168	58
pusillus	6	242	204	189	55
	9	272	198	192	54

Considering the curves representing the head lengths of *artedi*, it is seen that there is considerable difference between this character in two populations within the same lake, namely the Port Credit and Bay of Quinte populations in Lake Ontario. The curve representing the head length of the Great Bear Lake *lucidus* lies between the curves for the two Lake Ontario populations. The size range and the number of specimens in the Great Bear Lake collection is not nearly as great as that of the Lake Ontario populations, which may account for the difference in the slope of the curve, although there is no reason why the change with growth should be the same in the two bodies of water.

The relatively close similarity of the head length of the Lake Ontario, Great Bear Lake, Baker Lake and *laurettae* populations in contrast to the wide divergence of the head length of these populations with that of *nigripinnis* and *pusillus* is well shown in this figure.

If we next consider dorsal height, the same situation is seen. The curves representing this character in the Lake Ontario, Great Bear Lake, Baker Lake and *laurettae* populations approximate one another much more closely than any of them do the curves representing the same character in *nigripinnis* or *pusillus*. The smallness of the size range and number of specimens represented is undoubtedly responsible for the direction of the slope of the curve representing *pusillus*. These curves illustrate graphically the fact that, as compared with *laurettae*, *pusillus* has a much smaller head but very much longer dorsal fin.

Similarly in the case of eye diameter, the Lake Ontario, Great Bear Lake, Baker Lake and *laurettae* populations show considerable similarity in contrast to the wide divergence of *nigripinnis*. In eye diameter *pusillus* is similar to the Lake Ontario *artedi*. This illustrates what has been said above that for each species there is a particular *combination* of characters. As compared with *artedi*, *pusillus* has much shorter head, very much longer fins but eye of similar size. Within the same species, eye size usually varies with head length,—an individual with large head will have a large eye in relation to standard length. In *pusillus*, the eye is similar in size to that in *artedi*, whereas the head is much shorter; in other words the eye of *pusillus* is much larger relative to head length. It will be remembered that a popular name for this species in the Mackenzie basin is "big eye".

Consideration of other characters in addition to those just considered confirms the opinion that *lucidus* is closely related to *artedi*. Pritchard (1931, p. 29) gives the average gill-raker count of Lake Ontario *artedi* as 47 and the range as 42 to 52. For *lucidus* the corresponding figures are 45.6 and 42 to 50. We have already seen that in the case of *Coregonus* gill-raker counts are lower in the northwest.

Great Bear Lake *lucidus* have more scales than Lake Ontario *artedi*, 81 average, and a range of 75 to 89 as compared with 72 and 67 to 79. It will be remembered that in considering *Coregonus*, it was found that gill-raker number was found to be more nearly constant and to show a more definite geographical trend than did number of scales.

It is therefore concluded that *lucidus* is merely a local form of *artedi*. If it is considered desirable to recognize subspecies of *artedi*, the Great

Bear Lake population will be known as *Leucichthys artedi lucidus.* As in the case of *Coregonus*, it is the opinion of the present author that, until the relation between various ecological conditions and the morphometric characters of *Leucichthys* are understood, the recognition of subspecies in this group is likely to lead to more confusion than understanding. I find myself in agreement with Hile (1936) who concluded that "the differences upon which the separation of many subspecies (of *artedi*) have been based are too slight and indefinite in comparison with the wide range of natural variation of the character used" and that "pending the accumulation of adequate data for the separation of *artedi* forms according to their true and natural relationships, it would appear that the designation of a local form can be made best through a description of its salient characters and a recording of the locality it inhabits".

BAKER LAKE *LEUCICHTHYS*

The above discussion has included a comparison of the characters of *Leucichthys* from Baker Lake and vicinity with those of Lake Ontario and Hudson Bay *artedi.* This comparison has brought out the similarity between these three populations in the matter of head length, dorsal fin height and eye diameter. The small number of specimens may be responsible for the differences in gill-raker and scale counts between the Great Bear Lake and Baker Lake populations, although as we have seen in the case of *Coregonus*, such small differences between neighbouring bodies of water are to be expected. Pritchard (1. c.) found a considerable difference in number of scales in Lake Ontario *artedi* of different sizes. Whether this is due to difference between different year classes or is related to some other character has never been determined.

The present collection of Baker Lake *Leucichthys* may therefore be regarded as belonging to the species *artedi.*

RELATIONSHIP OF *LAURETTAE* TO *ARTEDI*

The resemblance of *laurettae* to *artedi* has been noted by Bean (1882b; 1884; 1890; 1894) and to *lucidus* by Evermann and Smith (1896) and Jordan and Evermann (1896; 1911).

Figure 1 illustrates the similarity in head length, dorsal fin height and eye diameter between *laurettae* and various populations of *artedi. laurettae* however has a considerably lower gill-raker count than Great Lakes *artedi* or Great Bear Lake *lucidus*, here regarded as a form of *artedi.* The average and range in gill-maker numbers of these forms is as follows:

		Gill-rakers	
	Authority	*Average*	*Range*
Lake Ontario *artedi*	Pritchard (1931)	47	42-52
" " *artedi artedi*	Koelz (1929)	47.9*	41-54
" " *artedi albus*	"	47 *	
Lake Erie *artedi artedi*	"	47.3*	44-51
" " *artedi albus*	"	46.3*	41-53
Lake Huron *artedi artedi*	"	47.1*	40-53
" " *artedi manitoulinus*	"	45.9*	43-50
Lake Superior *artedi*	"	47 *	38-53
Lake Nipigon *artedi*	"	47.5*	41-53
" " *artedi*	Dymond (1926)	46	41-57
Great Bear Lake *lucidus*		45.6	42-50
Hudson Bay *artedi*	Dymond (1933)	43	40-46
laurettae		42	38-47

*Average from Koelz's tables 67-78.

It is thus seen that while *laurettae* diverges considerably in gill-raker number from Great Lakes *artedi* and Great Bear Lake *lucidus*, the divergence between it and Hudson Bay *artedi* is not nearly as great. Whether the salt water habitat has something to do with the low gill-raker count is not known; there is not the same correspondence between the number of gill-rakers of Hudson Bay and Kittigasuit *Coregonus*.

As has already been pointed out, the premaxillaries of *laurettae* are usually nearly vertical, whereas in typical *artedi* they are at a wide angle to the vertical. Because of this character and the divergence in number of gill-rakers as well as on distributional grounds, the *Leucichthys* which have been designated as *laurettae* should continue to be regarded as distinct from *artedi* although it is admitted that it may be impossible to distinguish occasional specimens. In any case, *artedi* is close to the *laurettae* which is here considered synonymous with the Asiatic *autumnalis*.

LEUCICHTHYS ARTEDI IN NORTHWESTERN CANADA AND THE RELATION THERETO OF *L. TULLIBEE*

L. artedi is the most widely distributed of all the species of *Leucichthys*, both ecologically and geographically.

The lake herrings living in the streams tributary to Hudson and James Bays and resorting to salt or brackish waters at certain seasons have been identified as belonging to this species (Bean 1882a, Dymond 1933). Typical *artedi* have been identified in a collection made by Dr. D. S. Rawson in Reindeer Lake, northern Saskatchewan, and the preceding discussion has shown that the same species occurs in waters farther north and west (Baker Lake and river between Beverley and Aberdeen Lakes and also in Great Bear Lake). Undoubtedly the species is found in all suitable waters in intervening and surrounding areas.

The name *tullibee* was given by Richardson (1836) to a form of *Leucichthys* which he said was "very generally diffused through the waters of the fur countries". His description was based on specimens from Cumberland House on Pine Island Lake in northern Saskatchewan. Redescription of specimens from this locality has been given by Dymond (1928). If the lengths of the heads and eyes of the specimens whose measurements are given in this account are plotted on figure 1 it will be found that they approximate much more closely to the values for *nigripinnis* than to those of *artedi.* Moreover there occurs in western lakes south of the Precambrian shield a *Leucichthys* which possesses many of the features of *nigripinnis.* Specimens available for study are too few to enable a decision to be reached as to the status of this form or as to the possible relationship of *tullibee* to *artedi* or *nigripinnis.* Koelz's (1931) assumption that *tullibee* is a subspecies of *artedi* may be unwarranted. The same applies to his description as subspecies *magnus* (of *artedi*) of a *tullibee*-like form from Lesser Slave Lake and as subspecies *winnipegosis* of closely related forms from Lake Winnipegosis in Manitoba and from a number of lakes in northwestern Ontario. In any case, there is serious doubt as to the wisdom of recognizing subspecies among coregonine fishes at the present time.

LEUCICHTHYS ZENITHICUS

The species identified as *zenithicus* and recorded as such from Lake Winnipeg and Lake Athabasca by Dymond and Pritchard (1930) is now regarded as extending into the Northwest Territories.

I have been privileged to examine a collection of 13 specimens which I identify as *zenithicus* taken by Dr. D. S. Rawson of the University of Saskatchewan in Reindeer Lake, northern Saskatchewan, during the summer of 1942. Three of these specimens were taken from the stomachs of *Cristivomer.* Study of these various collections has convinced me that the specimens regarded as the types of the species *macrognathus*, *athabascae* and *entomophagus* by Harper and Nichols (1919) may all be identified as *zenithicus.*

Koelz (1929) characterizes *zenithicus* as "elongate, subterete fishes of relatively moderate size, with short, usually included mandible, relatively long snout and maxillary, shallow head and a moderate number of gill-rakers and lateral line scales". Referring to the characteristically long maxillary, Jordan and Evermann (1911) and Dymond (1926) call *zenithicus*, the longjaw.

Table 10 presents proportionate measurements of specimens from a number of localities, including measurements made by the author on the type specimens of *Leucichthys macrognathus*, *L. athabascae* and *L. entomophagus*, preserved in the National Museum of Canada.

TABLE No. 10

PROPORTIONATE MEASUREMENTS OF *Leucichthys zenithicus* FROM LOCALITIES IN NORTHWESTERN CANADA

A. Average for 6 specimens from Lake Nipigon, from Dymond (1926).
B. Average for 6 from Lake Winnipeg.
C. Average for 7 from Lake Winnipeg.
D. Average for 2 from Reindeer Lake, Sask.
E. Average for 4 from Reindeer Lake.
F. Average for 4 from Reindeer Lake.
G. Type of *L. macrognathus*.
H. Type of *L. athabascae*.
K. Type of *L. entomophagus*.

The measurements for G., H., and K. were made by the author on type specimens in the National Museum of Canada.

	A	B	C	D	E	F	G	H	K
Standard length	272	261	231	264	165	144	201	137	134
Scales	70	65	64	74	76	66	65	65	...
Gill-rakers	37	38	38	37	36	34	37	35*	35
Head length	246	237	249	242	246	256	239	241	239
Head depth		156	166	160	160	163	149	146	157
Eye	57	62	65	59	68	72	57	66	71
Snout	70	57	63	68	65	67	62	58	63
Interorbital	54	60	62	68	63	65	50	55	63
Maxillary	96	86	93	94	96	98	90	91	90
Body depth	243	281	298	246	225	218	219	182	239
Body width	112	146	149	137	114	120	109	80	112
Caudal peduncle									
Length	127	121	117	128	131	125	129	117	101
Depth	73	93	96	80	78	77	67	78	83
Dorsal height	173	192	202	157	161	160	195	153	157
Dorsal base	117	117	117	114	112	104	114	106	131
Anal height	110	131	121	100	101	99	122	...	97
Anal base	105	117	121	102	105	105	107	102	123
Pectoral length	169	178	199	159	158	159	216	161	164
Ventral length	163	163	200	158	156	158	179	164	160

*As stated by Harper and Nichols.

This table emphasizes a fact already noted in connection with several species, namely that gill-raker number is the most stable of the characters generally used to distinguish species of coregonine fishes. The average number of gill-rakers of 20 *zenithicus* from Lake Superior listed by Koelz (1929, table 25) is 39.4 and for Lake Nipigon, 37.6. The total range of gill-raker number for Great Lakes *zenithicus* given by Koelz is 32 to 46. The range found for the 23 specimens from Lake Winnipeg and Reindeer Lake was 29 to 40. The specimen which had 29 on the left arch had 35 on the right. Apart from this abnormal specimen, 33 was the lowest gill-raker count found. The numbers of gill-rakers possessed by the specimens described by Harper and Nichols under the names *macrognathus*, *athabascae* and *entomophagus* correspond to those characteristic of *zenithicus*.

Number of scales in the lateral line shows a greater variation geographically than does number of gill-rakers. Twenty Lake Superior specimens listed by Koelz (table 25) had an average of 78 scales, with a range of 69 to 90 for 956 specimens. Twenty from Lake Nipigon listed by the same author had 73.5 scales. While the specimens designated as *macrognathus* and *athabascae* have fewer scales than most collections of *zenithicus*, the numbers are well within the range for *zenithicus* and are the same as those of collections B and C. A low number of scales is a characteristic feature of *zenithicus*.

A long maxillary is another characteristic *zenithicus* feature. In this character also, *macrognathus*, *athabascae* and *entomophagus* agree with *zenithicus*.

Body depth appears to be one of the most variable of body proportions in *zenithicus*. Koelz (1929) noted that "those small fish that have been taken from depths of more than 60 fathoms appear to have, on the average, a slightly shorter snout and greater body depth" and "rather marked variations are exhibited by the small specimens". The type of *L. athabascae* differs markedly from normal *zenithicus* in body depth and width, but its other characters place it definitely in that species.

Fin length is another character in which there is marked difference between populations of *zenithicus* from different localities. Lake Winnipeg specimens (B and C, table 10) have considerably longer fins than Lake Nipigon (A) or Reindeer Lake (D, E, F) specimens. Similarly the type of *macrognathus* has longer fins than the types of *athabascae* and *entomophagus*.

Considering the combination of characters possessed by *macrognathus*, *athabascae* and *entomophagus*, there can be no doubt that they belong to the species here designated as *zenithicus*.

The type of *macrognathus* came from Great Slave Lake, of *athabascae* from Lake Athabaska, and of *entomophagus* from Tazin River. *L. zenithicus* has already been reported from Lake Athabaska (Dymond and Pritchard, 1930).

LEUCICHTHYS NIGRIPINNIS

Leucichthys nigripinnis has not yet been recognized from the waters of the Northwest Territories proper. Dymond and Pritchard (1930) recorded it from Lake Winnipeg, Manitoba; Waskesiu, Little Trout, Burntwood and Heart Lakes in Prince Albert National Park, Saskatchewan, and from Lake Athabaska, Alberta, and recently the present author recognized the species in a collection made by Dr. D. S. Rawson in Reindeer Lake, northern Saskatchewan.

STENODUS

In America *Stenodus* is confined to Alaska, Yukon and Northwest Territories. The genus also occurs in the Arctic drainage of Asia as far west as the White Sea; an isolated colony is found in the Caspian sea. See map in Dymond and Vladykov (1934). Berg (1932) regards the Asiatic and American populations as constituting a single species, *Stenodus leucichthys.* The form occupying the Arctic drainage of Asia is regarded as subspecies *nelma*, that is, *Stenodus leucichthys nelma.*

Richardson (1823) gave the form found in the Mackenzie basin the specific name *mackenzii* and this name has been generally applied to it since that time.

The fish was early given the common name inconnu by the French Canadian voyageurs. On the Yukon it is said to be called acouda, perhaps a corruption of inconnu. Hearne's (1795) account of the taking of a specimen in Great Slave Lake in 1772 is perhaps the earliest published reference to this fish in Canada. He does not mention it by name but his description can hardly refer to any other species. Mackenzie (1801) speaks of catching in his nets in Great Slave Lake on June 9, 1789, "Carp (suckers), *poisson inconnu,* whitefish and trout". Also "on July 13th at the mouth of the Mackenzie the nets yielded seven *poisson inconnus* which were unpalatable".

DESCRIPTION

Proportionate measurements of 13 individual specimens are given in table 11. A description based on the measurements of 11 specimens over 60 cm. in standard length, all from Slave River (Great Slave Lake population), is as follows. The measurements are in percentage of the standard length.

Head length, 26.7 (25.9-27.7; head depth 15.3 (14.5-15.7); eye, 3.5 (3.2-3.8); snout 6.0 (5.7-6.5); interorbital 4.8 (4.4-5.2); maxillary 9.4

(9.0-9.8) reaching a vertical through middle of eye, sometimes nearly to posterior margin of eye; body depth 21.3 (20-23.5), deeper in larger specimens, 24.5 in one 97.8 cm. long; body width 13.2 (12-14.9); caudal peduncle length 11 (10-11.6) and depth 7.1 (6.5-7.8); dorsal fin usually with 12 or 13, rarely 11, fully developed rays, preceded by 1 or 2 shorter rays; its height 15 (13.3-16.6) and its base 11.3 (10.4-12.3); anal with 14 or 15, rarely 13, developed rays preceded by one or two shorter ones, its height 12.5 (11.7-13.8) and base 11.8 (11-13); pectoral fin with 16 or 17 rays, its length 16.6 (16.1-17.6); ventral with 11, rarely 12, rays, its height 15.2 (13.8-16.2); caudal length 17.8 (17.4-20.6); adipose 7.1 (5.5-8.1), branchiostegals 10 or 11; scales 103 (100-107) to end of vertebral column; gill-rakers 7 + 14 (7 + 12 to 8 + 15), the longest 15 to 20 mm. in length; pyloric caeca 144, 159 and 182 respectively in the three specimens examined, 2-3 cm. long.

TABLE No. 11

PROPORTIONATE MEASUREMENTS AND COUNTS OF BODY PARTS OF *Stenodus*.

Specimens 5185-5195 and 5137 are from Slave River. No. 5642 is from Arctic Red River and 5682 from the Yukon River near Dawson.

Number	5188	5185	5189	5187	5193	5195	5191	5194	5137	5190	5192	5642	5682
Standard length	745	688	687	681	680	675	660	642	640	635	608	595	313
Scales	102	100	107	103	105	104	105	102	100	105	101	97	99
Gill-rakers	23		21	21	23	21	21	23	19	21	21	19	20
Branchiostegals	11	11	11	11	12	10	10	10		10		10	10
Pyloric caeca					159	144			182				
Head length	261	264	259	274	277	267	272	272	260	259	271	271	319
Head depth	157	155	152	157	155	152	153	152	157	145	153	140	187
Eye	32	38	36	35	34	37	36	37	35	34	34	42	58
Snout	62	57	59	60	65	61	60	62	64	58	57	62	73
Interorbital	48	49	44	47	46	52	45	49	47	49	49	45	58
Maxillary	95	91	91	95	98	92	97	96	95	91	90	94	117
Body depth	217	235	212	212	215	200	211	210	221	201	205	195	246
Body width	146	149	132	138	130	130	137	128	124	121	120	119	163
Caudal peduncle													
Length	111	110	116	108	115	109	113	106	100	110	113	96	136
Depth	67	78	71	73	74	65	73	74	75	70	66	74	93
Dorsal rays	15	13	13	13	14	14	14	12		14		14	15
Dorsal height	139	157	152	148	157	142	166	157	133	143	166	155	212
Dorsal base	113	109	109	104	123	114	112	116	117	118	108	107	141
Anal rays	16	16	16	16	15	15	15	15		16		16	15
Anal height	122	130	120	123	138	118	136	130	117	119	127	134	150
Anal base	120	116	110	110	116	120	116	130	120	121	119	121	143
Pectoral length	163	165	163	176	171	161	174	165	165	165	161	175	179
Ventral length	138	145	155	154	156	153	162	154	148	154	153	155	172
Adipose length	70	81	75	66	72	69	55	77		74	75	56	
Sex	♀	♀	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	

The lower jaw is longer than upper and usually somewhat hooked; supplementary maxillary as wide as the maxillary; bristle-like teeth on palatines, vomer, tongue, premaxillary and head of maxillaries, much weaker ones anteriorly on lower jaw; nostrils with two flaps as in *Coregonus*. Caudal fin edged with darker, dorsal dusky at tip; other fins immaculate.

It will be noticed that the 2 females are larger than any of the males. The measurements suggest that males have deeper and wider bodies than females.

The identity of *S. mackenzii* of the Mackenzie and Yukon Rivers and *S. leucichthys nelma* of Siberian rivers has often been suggested (Scofield 1899, Halkett 1913, Melville 1914, Berg 1932).

Berg gives the scale and gill-raker counts of *nelma* as 88-118 and 18 (19-23) respectively. The former is a wider range than found in the specimens of Mackenzie River fish available for study but the gill-raker count is similar in the two areas. Berg is probably correct in regarding the American species as conspecific with the Asiatic. In that case, ours should be known as *Stenodus leucichthys mackenzii* if subspecies are recognized.

DISTRIBUTION

Melville (1914) gives the general distribution of the inconnu as follows: ". . . inhabiting, as far as the first rapids, most of the large rivers and streams of Alaska and Arctic Canada from the Yukon to the Anderson river." The Anderson appears to be the most easterly of the rivers occupied by the inconnu. So common is the species in this river that it is said to be called Connie River. Anderson (1913) said that he had never seen an inconnu east of Cape Bathurst.

From available information it appears that the inconnu in the Mackenzie basin is largely confined to Great Slave Lake and the lower Mackenzie as far south as the ramparts. The only record for Great Bear Lake is that of Simpson (1843) who reported one caught in a white-fish net near Fort Confidence at the eastern extremity of the lake. The United States National Museum has a specimen from Fort Simpson, where specimens are taken in the fall.

From Great Slave Lake they ascend at spawning time many of the tributary streams including Slave River as far as the rapids at Fort Smith. Melville (l.c.) said that they ascend most of the rivers flowing into the lake from the north but the Riviere de Rochers (now Taltson River), Stony Island, Buffalo and Slave Rivers were said to be those visited in largest numbers. Sergeant Mellow, R.N.W.M.P., is quoted as saying "that he was nearly able to walk across the Buffalo River on their backs". This statement apparently refers to the Big Buffalo River; Chambers (1914) quotes Mellor as describing the ascent of the Big Buffalo River as follows, "The river was literally alive with 'coneys' . . . . It was quite unnecessary to use a net or line to catch them as it was a simple matter to throw them on land with a paddle or stick".

Frank Conibear reports having taken inconnu in the Taltson River. He reports heavy runs on the Big Buffalo River but doubts if they are as abundant in the Little Buffalo or in the Hay. Preble (1908) took it at the lowermost rapid on the Grandin River. Mr. Alf Reeve of Toronto has caught an inconnu at the mouth of the Yellowknife River on a troll.

So far as movement of inconnu in the lower Mackenzie is concerned Melville said they did not ascend beyond Swift River above Fort Good Hope. They were said to be less abundant in the lower Mackenzie than in Slave River although some are taken in gill nets every summer at all the trading posts. Tributaries of the lower Mackenzie in which the inconnu are known to be found include the Peel, Rat and Arctic Red Rivers. West of the mouth of the Mackenzie, the inconnu is not known beyond Herschel Island (Anderson, 1913).

Evermann and Goldsborough (1907a) recorded the inconnu from the headwaters of the Yukon and our collection contains a specimen from that river. Bean (1894) gives its distribution in Alaska as "from the Kuskoquim to the Kuwuk".

LIFE HISTORY, FOOD VALUE, ETC.

In the lower Mackenzie the inconnu is regarded as anadromous, wintering about the delta and entering the Mackenzie and some of its tributaries for spawning. The movements however have never been critically observed. Berg (1932) describes the Siberian *Stenodus* which is popularly called *nelma*, as a semi-migratory fish which begins to enter the rivers after they are free of ice.

Mr. K. H. Lang describes the inconnu as abundant in the delta region of the Mackenzie. It seems to prefer the larger channels to the smaller ones. It is said to be most abundant in the shallow water over the large mud flats on both sides of Richards Island and of other islands to the west. It goes out into quite brackish water. Mr. Lang reported that three men in 21 days caught 9,000 inconnu at Kidluit during the fall of 1935. The water there is quite brackish. The inconnu caught at that point in the fall (September) are mostly young fish. They come in from the open, brackish flats, and appear to be on their way to the Mackenzie. On their inward migration they follow the shores of the island quite closely.

Anderson (1913) says inconnys are "found in brackish and salt water . . . occasionally as far west as Herschel Island . . . . Large numbers are caught in gill-nets in brackish water at Shingle Point, Mackenzie Bay in July and August, but the flesh is rather soft and flabby at that season. Eskimo catch many with barbless hooks through the ice on the east mainland side of Richards Island in October, November and December. The connies are fat and firm of flesh at that season".

The fact that most of the inconnu caught in the fall among the islands are young fish suggests that perhaps the larger individuals move into the Mackenzie earlier than the smaller ones. Considerable numbers are said to enter the Peel and Rat Rivers in July and August. Mr. H. V. Dempsey states that in the Peel River, from its junction with the Mackenzie up to Fort McPherson, he has seen young inconnus twelve to eighteen inches in length caught in great numbers during the month of August. In August 1934, he saw at Fort McPherson 527 young inconnus caught in two hundred yards of five-inch-mesh gill-net set for only two hours, from 6 to 8 a.m. According to Berg (1932) "from the delta of the Kolyma the nelma runs up throughout the whole of June, while in July it is rarely found in the delta; in August and September only sexually immature nelma are found". One reason for fall fishing among the islands appears to be that at this time the weather, in the words of Mr. Lang "is cold enough for the fish to be thrown right into the scow and later transported up the river to Aklavik; although smelling to high heaven, they make excellent dog feed for the winter".

From Great Slave Lake the inconnu enters the tributary streams on their spawning migrations from the end of July until the freeze-up. Mr. Frank Conibear, who secured 12 specimens for the Royal Ontario Museum of Zoology at Fort Smith in September, 1933, says that on the Slave River the catch is at its height about the first part of September. Some indication of their numbers is given by the statement that a man could catch from 5 or 6 to 20 a day at the height of the run. With reference to their occurrence in other streams he wrote: "In September, 1914, went to the mouth of the Taltson River; practically all the fish caught there were coneys. Just at the entrance the river opens out in a small shallow lake about a mile wide; in the middle of the lake there is a bar about 2 or 3 feet deep. Each day I passed here twice and always ran into a shoal of coneys apparently sleeping. At the end of September, 1916, I went back to the same place, but did not do so well, so went up to the first rapids on the Taltson about 25 miles; here the fishing was good. We set one three pound bundle of nets, and overnight caught, if my memory is correct, 150 coneys, and a number of other fish. We had to make two trips with the boat, and in the evening there were almost as many. The Indians were catching all they wanted; there seemed to be no limit."

After spawning, the inconnu is believed to return to Great Slave Lake and to the delta region at the mouth of the Mackenzie. Preble (1908) quotes Père Giroux as saying that the inconnu pass Arctic Red River from about the second week in June to the first of August, and reach there on their return toward the end of October, and that they winter at the mouth of the Mackenzie, and also that they "ascend the Mackenzie in summer but apparently do not winter in that stream." We have already recorded their capture there in winter by the Eskimos. They are said to be incapable of surmounting rapids, although they will pass through quite swift water.

The inconnu is of considerable value as a food fish. Mr. Lang, who has spent many years in the Aklavik area, says: "It is a beautiful fish and in very much favour as human food, and also as dogfood, although the smaller connie are a little dry and lean; but the bigger they are, the fatter they get, and a piece of the tail of a big connie is generally considered the best feed of fish obtainable in the country". The palatability of the inconnu appears to be a matter of taste. Richardson (1836) wrote: "Its flesh is white, and when in good condition, tolerably palatable, though rather soft and oily, and soon becoming disagreeable when used as daily food; it is firmest and best near the mouth of the Mackenzie, and when out of season is considered by the natives to be very unwholesome". They are usually preserved for use by being dried or smoked. The fish are generally split and hung on a stage out of reach of the dogs.

The largest inconnu of which I have record weighed just over 63 pounds. This fish was taken by Mr. K. H. Lang at his Camp 3 (see map) on July 12, 1936. It was 59¼ inches in length. Mr. Lang described it as "rolling fat. I took 6 lbs. of fat from the entrails, then I had a big dinner and fed 17 sleigh dogs out of it besides". The largest inconnu seen by Mr. Harry V. Dempsey, of the Fisheries Service, Alberta Department of Agriculture, in several years fur-trading at Fort McPherson, Aklavik and Tuktuyaktok (Port Brabant) weighed 56½ pounds. Mr. Lang reports that he has seen several inconnu between 45 and 55 pounds in weight; 25 to 30 pound fish are quite common, while the average run is from 6 to 12 pounds. It is said to be less common and not to reach as large a size on the Yukon. Hon. George Black informed me that they occur at Dawson City up to 14 pounds in weight.

The stomachs of six of the specimens in the present collection contained food. In every case this consisted of fish or fish remains, as indicated below:

Museum number	*Length in cm.*	*Stomach contents*
5190	63.5	Remains of *Esox lucius* 6" and 7" long respectively.
5137	64.0	3 *Pungitius pungitius*, each 1" long; remains of one other fish 1½" long.
5191	66.0	1 *Esox lucius* 7".
5195	67.5	1 *Esox lucius* 7¼", remains of one other fish.
5193	68.0	1 *Amphiodon alosoides* 5¼".
5185	68.8	1 *Amphiodon alosoides* 5¾", 1 *Esox lucius* 6", remains of one other fish 6".

The above specimens were all taken at Fort Smith, 5137 on Aug. 28, and the others in September. Speaking of the food of the inconnu of the lower Mackenzie, Mr. Lang says "For the summer, the stomach of most connies caught contains vegetable matter, only a few have small fish in them, but at Camp 1 this fall in October, I have examined 20 connies and they all contained nothing but fish. I give the stomach contents of an 8 lb. connie as a fair average example: 10 small ling (*Lota*) and jackfish (*Esox lucius*) about 2 to 3 inches long, and about 300 sticklebacks."

As has already been said, the inconnu, at least at certain seasons, will take a bait or lure. The Eskimos in the delta region catch them through the ice on barbless hooks (Anderson), by means of a spoon or bait, such as a piece of meat or fish, or on a hook baited with a thin strip of bone or ivory (Melville) or by line and hook without barbs, baited with whitefish gut or sometimes just a piece of white bone (Lang). Hon. George Black reports that on the Yukon at some seasons of the year they furnish good sport with a troll or minnow. He describes them as hard fighters. This is in contrast to the condition on the Mackenzie where it is described as "a fish of no great vitality, it being generally found dead in the nets, as compared to the whitefish or trout which caught at the same cast are still full of life" (Melville). Lang says "the real big connie never fight the net".

Efforts to determine the ages of the specimens in the present collection were not very successful, owing to the difficulty of reading the scales. The scales of the two largest specimens, both females, were illegible. The others, all males, 26 to 29 inches long to fork of tail; 608 to 687 mm. in standard length), appeared to be 8 to 10 years old. These were all taken at Fort Smith and hence were of the Great Slave Lake population. However, a specimen 690 mm. in standard length taken at Fort McPherson appeared to be of the same age so that the present collection gives no evidence of a difference in growth rate between the Great Slave Lake and lower Mackenzie populations.

Attention has already been drawn to the fact that the 2 females in the collection from Great Slave Lake were larger than any of the males. Berg (1932) in discussing the Caspian Sea form gives the weight and length of sexually mature females as 18.6 kg. and 90-95 cm. respectively and the corresponding figures for mature males as 16.0 and 80-90. Berg also reports that Kolyma males reach sexual maturity at 11-12 years of age, females ordinarily from 14 years. Males above 16 years of age are not found, while females are found at 20+ years of age. The same author gives the length (to the end of the middle rays of the caudal) of Pechora River nelma of various ages as follows:

At end of 4th winter	300 mm.
" " " 6th "	436 mm.
" " " 8th "	573 mm.
" " " 10th "	675 mm.
" " " 12th "	776 mm.
" " " 14th "	846 mm.
" " " 16th "	904 mm.

POSSIBILITY OF RACIAL DIFFERENCES IN AMERICAN *STENODUS*

Asiatic populations of *Stenodus* consist of a freshwater form *Stenodus leucichthys leucichthys* in the Caspian Sea and a migratory form *Stenodus leucichthys nelma* in the rivers of Siberia as far west as the White Sea. As already suggested, the *Stenodus* of the Mackenzie basin appears to consist of a "land-locked" or freshwater form of Great Slave Lake and a migratory form of the lower Mackenzie.

Although the inconnu is reported from all of the posts along the Mackenzie including Norman, Wrigley and Simpson, they appear to be much commoner below Norman. They are practically unknown in Great Bear Lake. Preble (1908) says the inconnu "remains in Great Slave Lake the year round, but as far as I know this is the only inland lake which is thus distinguished."

Berg (1932) distinguishes the two Asiatic subspecies as follows:

a. Gill-rakers on the first arch 18 (19-23) 24. The basin of the Arctic Ocean.......................*Stenodus leucichthys nelma*

aa. Gill-rakers on the first arch 19-25, average 22-23. The basin of the Caspian Sea.........................*Stenodus leucichthys*

In his descriptions he gives the scales of *leucichthys nelma* as 88-118 and of *leucichthys* as 99-120, average 109.3.

The collection on which the present work is based was not large enough to give any clear indication as to whether the Great Slave Lake and lower Mackenzie populations have diverged morphologically.

Eleven of the specimens whose measurements and counts are given in table 11 were from the Slave River. The number of scales (to end of vertebral column) of these eleven specimens averages 103, with a range of 100 to 107.

The following specimens from the lower Mackenzie had the number of scales and gill-rakers indicated.

Specimen number	*Origin*	*Number of scales*	*Gill-rakers*
13443	Fort McPherson..................	98	22
13444	" "	103	20
5642	Arctic Red River..................	97	19

The average number of scales of these three is 99.3. The specimen from the Delta of Mackenzie recorded by Gilbert (1895) had 100 scales and 24 gill-rakers. Scofield (1899) gave the scales and gill-rakers of 3 specimens from the mouth of the Mackenzie as 103 and 22 respectively. It is not known whether the scales indicated by Gilbert and Scofield were to the end of the vertebral column as in the case of specimens examined in connection with the present work or to the end of the lateral line. If the latter is the case, they support the view suggested by the present collection, namely that the Great Slave Lake specimens have more scales than those from the lower Mackenzie. The one Yukon River specimen (5682) included in table 11 also had a reduced number of scales. Berg's description of the Asiatic forms also suggest a higher number of scales in the Caspian or freshwater form.

STENODUS X LEUCICHTHYS HYBRIDS?

Four specimens tentatively identified as hybrids are included in the collections from northwestern Canada. These are all skins. Details of their characters are included in table 12. The proportionate measurements cannot be as accurate as those of whole specimens but are believed to be sufficiently accurate for purposes of comparison with the parent species. Such measurements as standard length, depth, etc. have been carefully estimated for the purpose of constructing this table.

Hybrids between the Siberian ***Stenodus leucichthys nelma*** and two Siberian species, ***Leucichthys autumnalis*** and ***Coregonus muksun*** have been reported by Kuznetsov (1932).

The number of gill-rakers reported by Kuznetsov for the ***Stenodus*** x ***autumnalis*** hybrid is similar to that in the present specimens, namely 34. This he says is intermediate between the number in ***Stenodus*** (18-21) and in ***autumnalis*** (39-51).

In the four specimens here described, the lower jaw is included and

TABLE No. 12

PROPORTIONATE MEASUREMENTS OF PRESUMED HYBRIDS *Stenodus* × *Leucichthys*, TAKEN 6 MILES NORTH OT KIDLUIT, SEPTEMBER, 1938

Number	10927	10924	10928	10926
Standard length	512	480	440	420
Scales	85	85	80	80?
Gill-rakers	34	34	34	32
Branchiostegals	9	8	8	8
Pyloric caeca	223			134
Head length	193	199	195	210
Head depth	136	144	142	144
Eye	35	37	39	40
Snout	51	52	51	52
Interorbital	65	63	63	64
Maxillary	61	59	63	60
Body depth	205	171?	255	205
Body width				
Caudal peduncle				
Length	96	113	108	87
Depth	87	90	86	90
Dorsal rays	14	13	13	14
Dorsal height	144	146	148	150
Dorsal base	133	113	114	117
Anal rays	13	14	14	13
Anal height	109	102	75	104
Anal base	117	111	114	110
Pectoral length	147	154	173	157
Ventral length	143	139	148	140
Adipose length	83	77	82	69

the premaxillaries vertical. Kuznetsov's *Stenodus* x *autumnalis* hybrids had the upper jaw shorter than the lower as in *Stenodus*. If *L. laurettae* is the American form of *autumnalis* as suggested above, the specimens here considered are probably hybrids between *Stenodus* and *L. laurettae*. This is the interpretation placed on them by Mr. Lang, who secured them for us. He wrote: "Before I leave the connie (*Stenodus*) I will mention some fish caught at Camp 9 at Okivik three years ago. They had the appearance of herring but the size of a fair connie about 9-11 lbs. They decidedly were no herring and they lacked the long heavy lower jaw of the connie. I showed them to an old Eskimo and he said 'him halfbreed' and it certainly appeared to be just that. I caught about 6 or 7 both years I was there. This year I caught at Camp 8 a fish of such an appearance that I would call it a cross between a connie and a whitefish". They are not common according to Mr. Lang. The Eskimos have a name for the hybrid, Ekaluitnak. *Stenodus* they call Segak.

In the Lena River area of Siberia, Kuznetsov says "These hybrids present no exclusive rarity, for among the local population they are known under the special name of 'Andy-balyk' (Yakutian) or 'whitefish' (Russian) by which they distinguished from the 'nelma', 'omul' and 'muksun'."

SUMMARY

The species of coregonine fishes occurring in the Yukon and Northwest Territories of Canada are *Coregonus clupeaformis* (Mitchill), *Prosopium cylindraceum* (Pallas), *Leucichthys autumnalis* (Pallas), *Leucichthys sardinella* (Valenciennes), *Leucichthys artedi* (Le Sueur), *Leucichthys zenithicus* (Jordan and Evermann), *Stenodus leucichthys* (Güldenstadt).

Proportionate measurements of body parts and counts of gill-rakers, scales, fin rays, branchiostegals and in many cases, pyloric caeca based on original measurements are presented for all of the above species.

The following species are reduced to synonymy:—*Coregonus nelsonii* Bean, *C. kennicotti* Bean, *C. odonoghuei* Bajkov, *C. atikameg* Bajkov as synonyms of *C. clupeaformis*. Bajkov's record of *C. nasus* in Canada is also placed in the synonymy of *C. clupeaformis*. *Prosopium quadrilaterale* (Richardson) and *P. preblei* (Harper and Nichols) are synonymous with *P. cylindraceum*. Two species of *Leucichthys*, *pusillus* (Bean) and *laurettae* (Bean) found in and about the mouths of the rivers of Alaska and the Northwest Territories flowing into Bering sea and the Arctic Ocean are regarded as synonymous with *L. sardinella* and *L. autumnalis* of Siberia.

Leucichthys lucidus (Richardson) is synonymous with *L. artedi* and *L. entomophagus* (Harper and Nichols), *L. athabascae* (Harper and Nichols) and *L. macrognathus* (Harper and Nichols) with *L. zenithicus*. *Stenodus mackenzii* (Richardson) is synonymous with *S. leucichthys*.

Prosopium oregonium is recorded from Lesser Slave Lake, Alberta.

The *Coregonus* populations of a number of waters in the Yukon and the Northwest Territories are compared with Great Lakes *Coregonus* and it is shown that while the populations of different waters differ in body proportions and in such characters as number of gill-rakers, scales, etc., most of these characters show ecological rather than geographical variation. It is therefore concluded that until some relationship has been worked out between environmental factors and body characters of *Coregonus*, the recognition of subspecies on the basis of the characters of individual local populations adds to confusion rather than to enlightenment.

The same conclusion holds for all species of coregonines in the present state of our knowledge.

Number of gill-rakers is the most stable of the characters generally used to distinguish species of coregonines.

Number of pyloric caeca is one of the most variable of the characters studied.

Number of gill-rakers in *Coregonus* is the only character in which an approach to a geographical cline was found.

In the extreme northwest of Canada the typical number of gill-rakers in *Coregonus* is 22-23, in intermediate waters 25-26, in Hudson Bay, 26-27 and in the Great Lakes 27-28. However in Squanga Lake, Yukon Territory the number is 28.

Length of fins in *Coregonus* appears to show a definite correlation with ecological conditions in that collections from rivers had longer fins than collections from lakes.

The *Stenodus* of the Mackenzie River valley appears to consist of two populations,—a freshwater one in Great Slave Lake and an anadromous one in the lower Mackenzie. Some indication of differences in number of scales in the two populations was found.

Specimens regarded as hybrids between *Stenodus* and *L. autumnalis* are recorded from waters about the Mackenzie delta.

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A SYSTEMATIC STUDY OF THE MAIN ARTERIES IN THE REGION OF THE HEART

AVES X. STRIGIFORMES—PART I.[1]

FRED H. GLENNY[2]

ABSTRACT

Eight species of North American Owls were dissected and diagrams of the arrangement-patterns of the main arteries in the neck and thorax were prepared. The ligamentum aortae and right ligamentum botalli were prominent in each of the species.

The basic arrangement-pattern of arteries is essentially the same for all of the eight species. The owls present the condition *bicarotidinae normales* also found in the Falconiformes.

The Strigiformes do not present a highly elaborate arrangement of cervical blood vessels as is the case in several orders of birds.

INTRODUCTION

Recent studies on the main arteries of the neck and thorax of several orders of birds have made possible greater knowledge concerning arrangement-patterns of the main arteries in the cervical and thoracic regions. Although in some orders of birds there are several pattern-variations, the basic arrangement-pattern is usually representative for the order as a whole. The outstanding exception to this is, however, found in the Coraciiformes in which order two fundamentally different basic patterns are found (Glenny, unpublished papers, AVES VII). It is the writer's opinion that this present order represents not one single order, but possibly two or more orders, based on different structural characteristics, and that these two main groups show somewhat different relationships with respect to other orders of present-day birds.

The members of the Strigiformes show the typical bicarotidinae normales of Garrod (1873). This same condition is likewise found in the Falconiformes, and appears to have been regarded by Garrod as important in grouping these two present-day orders together, since he placed the Hawks (Falconidae) and Owls (Strigidae) in the same order (Accipitres).

Coues (1887) placed the Owls and Hawks in the order *Raptores* and assigned them Subordinal rank (Striges & Accipitres). This was based on the gross similarity, "Bill epignathous, cered; and feet not zygodactyle",[3] as well as certain other structural characteristics,[4] among which he includes the presence of two carotids.

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Huxley (1867) placed the "Raptorial" birds together and included them among the Desmognathous birds, based upon the bony structures chiefly. Of the Owls, he says, "In all the Owls the maxillo-palatines are thick and spongy, and encroach upon the intermediate valley, though they never completely unite with one another across it or obliterate its upper part. The basipterygoid processes are always present." In contrast with the Owls, in this respect, he states that, "In all the other Vultures, Hawks, and Eagles the maxillo-palatines unite with one another and with the largely ossified septum, and there are no basipterygoid processes. These, therefore, are, so far as their cranial characters go, the highest of birds of prey, or those which depart most completely from the embryonic condition."

With reference to other avian relationships Coues (1887) says, "The nearest relatives of the *Striges*, outside their own order, are the *Caprimulgi*—the relationship being really very close through the genus *Steatornis*. . . ."

Lowe (1939) uses the carotid arrangement (in the cervical region) as one of the characteristics for the establishment of avian relationships. This is, in the writer's opinion, in part, feasible, but not without some limitations, since the carotid arrangement alone does not aid in the finer points of ordinal differentiation. This has been discussed briefly by the author in a recent paper on the Coliiformes (Glenny, unpublished papers, AVES IX.).

MATERIALS

Eight species of North American Owls were used in this study. The materials were provided the writer by the Royal Ontario Museum of Zoology, Toronto, Ontario, Canada.

Specimens were dissected and diagrams of the arteries prepared. The number of specimens for each species is indicated after the name of the birds which were used.

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[3] Coues (1887), p. 496.

[4] Ibid., pp. 496-497. ". . . *Raptores* present several osteological and other anatomical characters. The sternum is ample and deep keeled, its posterior margin doubly or singly notched or fenestrate on each side, or entire with central emargination; the furculum anchylosed or not. . . . Aftershafts are present (usually), lacking in some Accipitres, all Striges and Catharides. There are two carotids; . . . The nature is altricial, yet ptilopaedic, the young being downy when hatched, and long fed by the parents in the nest. . . ."

Barn Owl, *Tyto alba* (Scopoli) (2)
Snowy Owl, *Nyctea nyctea* (Linné) (4)
Great Horned Owl, *Bubo virginianus* (Gmelin) (2)
Barred Owl, *Strix varia varia* Barton (2)
Long-eared Owl, *Asio wilsonianus* (Lesson) (2)
Short-eared Owl, *Asio flammeus* (Pontoppidan) (2)
Screech Owl, *Otus asio* (Linné) (3)
Saw Whet Owl, *Cryptoglaux acadica* (Gmelin) (2)

OBSERVATIONS

The basic arrangement-pattern for the species studied is largely characteristic for the group, although there may be some slight variation among individuals, with reference to the relative position of the axillary and coracoid major arteries.

The aortic root (1) arises in the left ventricle of the heart and passes diagonally to the right before dividing to form the left and right innominate arteries (2). The right innominate gives rise almost immediately to the right systemic (4th aortic) arch (3) which passes dorsally and somewhat laterally and then continues posteriorly and diagonally toward the centre of the body as the radix aortae (4) which then proceeds posteriorly in a medial position as the dorsal aorta (5). At the junction between the right radix and the dorsal aorta, the ligamentum aortae (7) is found as the ligamentous vestige of the embryonic left radix aortae. This ligament maintains its antero-lateral connection with the left pulmonary artery (8). The right ductus botalli remains, in all the species which were studied, as a fairly prominent ligamentum botalli (6), while its complimentary structure, the left ligamentum botalli, either completely atrophies or fuses in part with the ligamentum aortae (7). The right ligamentum botalli maintains its proximal connection with the right pulmonary artery and its distal connection with the posterior portion of the right radix aortae just anterior to the latter's connection with the complimentary left ligamentous vestige.

The innominate arteries give rise to the common carotid (10) and subclavian (9) arteries. The subclavian artery then gives rise to the axillary (12), coracoid major (13), intercostal (15) and two pectoral (16) arteries in order. The axillary artery sends off a small branch, the coracoid minor (11), while the sterno-tracheal (14) is derived from the coracoid major (13). In the Screech Owl, the coracoid major arises from the subclavian just medially to the axillary artery (Fig. 2).

Anteriorly the left and right common carotids give rise to the thyroid artery, ductus shawi (17), superficial cervicals—left (21) and right or ascending-oesophageal (25)—*vide infra*,—vertebral (23) and finally the

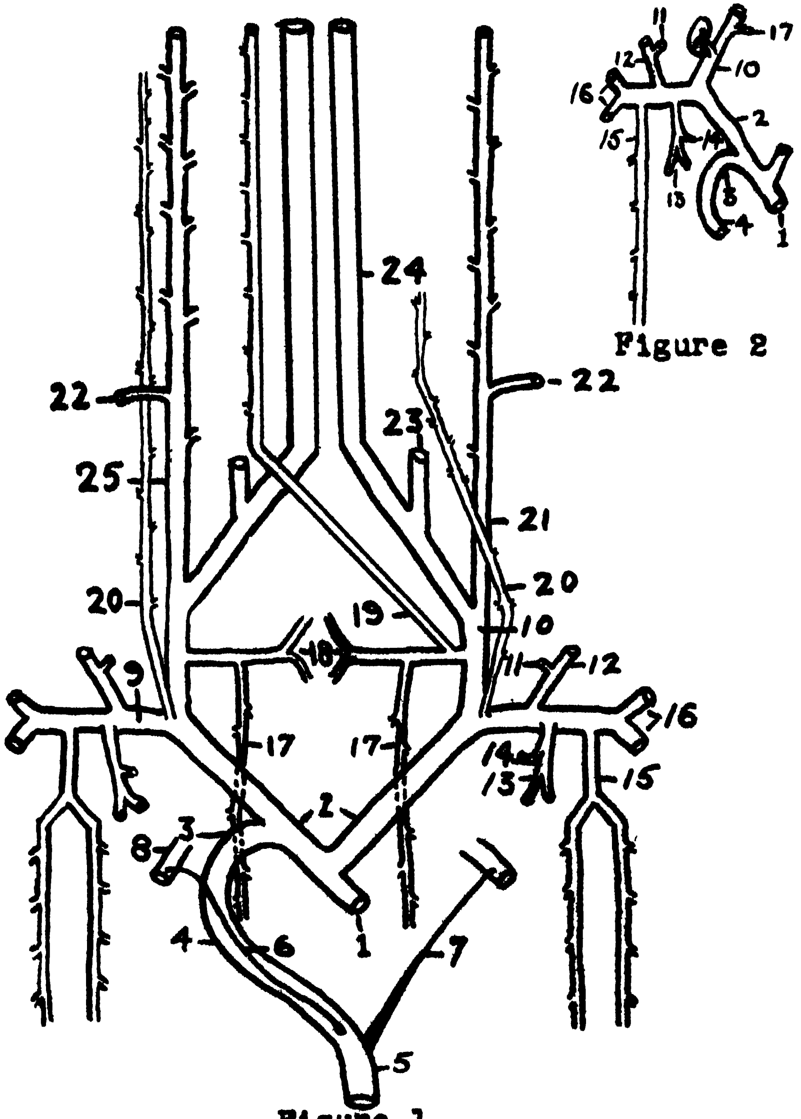

FIGURE 1.—Diagrammatic representation of the arterial arrangement in the neck and thorax of *Nyctea nyctea*. Ventral view.

FIGURE 2.—Diagram of part of the arterial arrangement in the thorax of *Cryptoglaux acadica*. Ventral view.

internal carotid (trunk) (24) arteries. The scapular artery (22) arises as a branch of the superficial cervical arteries (21 & 25).

In addition to the above arteries which go to make up the basic arrangement of cervical and thoracic arteries, the secondary ascending-oesophageal artery (19), which arises as a branch of the left ductus shawi, may be present in some species.

A pair of ventral superficial cervical arteries (20) was present in the Snowy Owl. These arteries, though small, arise independently from the innominate arteries at or near the base of the common carotids (Figure 1).

The right superficial cervical artery (25) serves as the primary ascending-oesophageal artery in the Owls, and in addition to this serves to supply the cervical lymph glands, connective tissues, and musculature (in part) of the neck. The ducti shawi send off branches to the trachea and syrinx (18) before passing posteriorly to supply the bronchi, oesophagus and other tissues dorsal to the heart.

The intercostal artery (15) divides into ventral and lateral rami in the Snowy Owl. In the Saw Whet Owl, however, two separate vessels are found to be present. One, the normal, arises in the expected position from the subclavian just before this vessel divides to form the two pectorals; the other intercostal, a smaller vessel, arises as a branch of the coracoid major artery and comes to serve as a ventral intercostal artery.

The Short-eared Owl presents a readily visible secondary ascending-oesophageal artery (19) which arises from the left ductus shawi.

DISCUSSION

From the foregoing observations we may note that the fundamental basic arrangement-pattern of the cervical and thoracic arteries is essentially the same, and varies only slightly in a few of the species. It should be noted further that, whereas in some orders of birds such as the Casuariformes (Glenny, 1942), Piciformes (Glenny, 1943), Coraciiformes (Glenny, unpub. papers, AVES VII), and Anseriformes (Glenny, unpub. papers, AVES VIII) there may be considerable elaboration of blood vessels in the cervical region, this is not generally the case in the North American Strigiformes. Whereas in most of the members of the above mentioned orders of birds there is a large oesophageal blood supply furnished by the right superficial artery and the ascending-oesophageal artery derived from the left side (ductus shawi or left common carotid), only two or three species of Owls were noted to have a secondary oesophageal blood supply derived from the left side of the neck. The chief oesophageal blood supply in the owls is derived, therefore, from the right lateral superficial cervical artery (25).

The presence of a prominant ligamentum aortae and of a likewise prominent ligamentum botalli may be in part correlated with certain post-hatching and nestling conditions frequently found among different orders of birds (Glenny, unpub. papers, AVES VII) and also found among the Strigiformes and Falconiformes (Coues, 1887).

It may be that apparent retention of certain embryonic vestiges is characteristic for most of the lower orders of birds, and that it has only minor phyletic significance.

It may be significant that the Strigiformes present two carotids as do the *Caprimulgidae* and *Steatornithidae* of Garrod. In this regard, it should be noted that the latter two families were placed in the order Macrochires by Garrod, but that the *Trochilidae* and most of the *Cypselidae* (except *Cypseloides fumigatus*) which were dissected by Garrod presented but one (the left) carotid artery which traversed the length of the neck to afford the cervical blood supply. The possible relationships between these two groups and the Passeriformes is dealt with in papers by Lowe (1939) and Glenny (unpub. papers, AVES IX).

ACKNOWLEDGEMENTS

The writer wishes to express his gratitude for the assistance given him in this study by the Royal Ontario Museum of Zoology, and to Dr. E. Horne Craigie for his several suggestions during the progress of this work and in the preparation of this paper.

KEY TO ABBREVIATIONS

(1) aortic root
(2) innominate arteries
(3) right systemic (4th aortic) arch
(4) right radix aortae
(5) dorsal aorta
(6) right ligamentum botalli
(7) left ligamentum aortae
(8) pulmonary artery
(9) subclavian artery
(10) common carotid artery
(11) coracoid minor artery
(12) axillary artery
(13) coracoid major artery
(14) sterno-tracheal artery
(15) intercostal artery
(16) pectoral arteries
(17) ductus shawii
(18) tracheo-syrinx arteries
(19) secondary ascending-oesophageal artery
(20) ventral superficial cervical arteries
(21) left superficial cervical arteries
(22) scapular artery
(23) vertebral artery
(24) internal carotid (trunk) artery
(25) right superficial cervical artery (primary ascending-oesophageal artery)

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THE BIRDS OF SIMCOE COUNTY, ONTARIO

By O. E. Devitt

PART ONE

GENERAL INTRODUCTION

In bringing together this account of the bird life of Simcoe County consideration has been given not only to recent scientific data, but also to the region's wealth of early natural history records embodied in the writings of some of the first white men who came into the Province of Ontario.

The county has been covered from boundary to boundary in a survey of its avian population, while more extensive studies have been made in areas such as Holland River, Barrie, Wasaga Beach, Penetanguishene, Giant's Tomb Island, Waubaushene, Severn Falls and Washago. Collecting has been carried on in practically all sections of the county, so that at the present time the writer's collection contains one or more representative specimens of most of the species known to occur in the region.

It is hoped that this account will serve a twofold purpose; that of adding something to our knowledge of the distribution of birds in Ontario, and of promoting interest in the study of ornithology in the county.

THE AREA COVERED

The area covered includes the entire county of Simcoe, the fourth largest county in the province of Ontario, with an area of approximately 1662 square miles. It lies between 43° 57′ and 44° 56′ north latitude and between 79° 18′ and 80° 17′ west longitude. The geographical position of the town of Barrie, which is about the centre of the county, is latitude 44° 23′ N., longitude 79° 41′ W., and its elevation 725 feet above sea level.

The county is bounded on the south by the Holland River, York and Peel Counties, on the west by Dufferin and Grey Counties, on the north by Georgian Bay and the Severn River and on the east by Lake Simcoe and Lake Couchiching. The area is rather irregular in shape, being somewhat longer than it is wide. The greatest length is approximately 68 miles and the greatest width is about 56 miles.

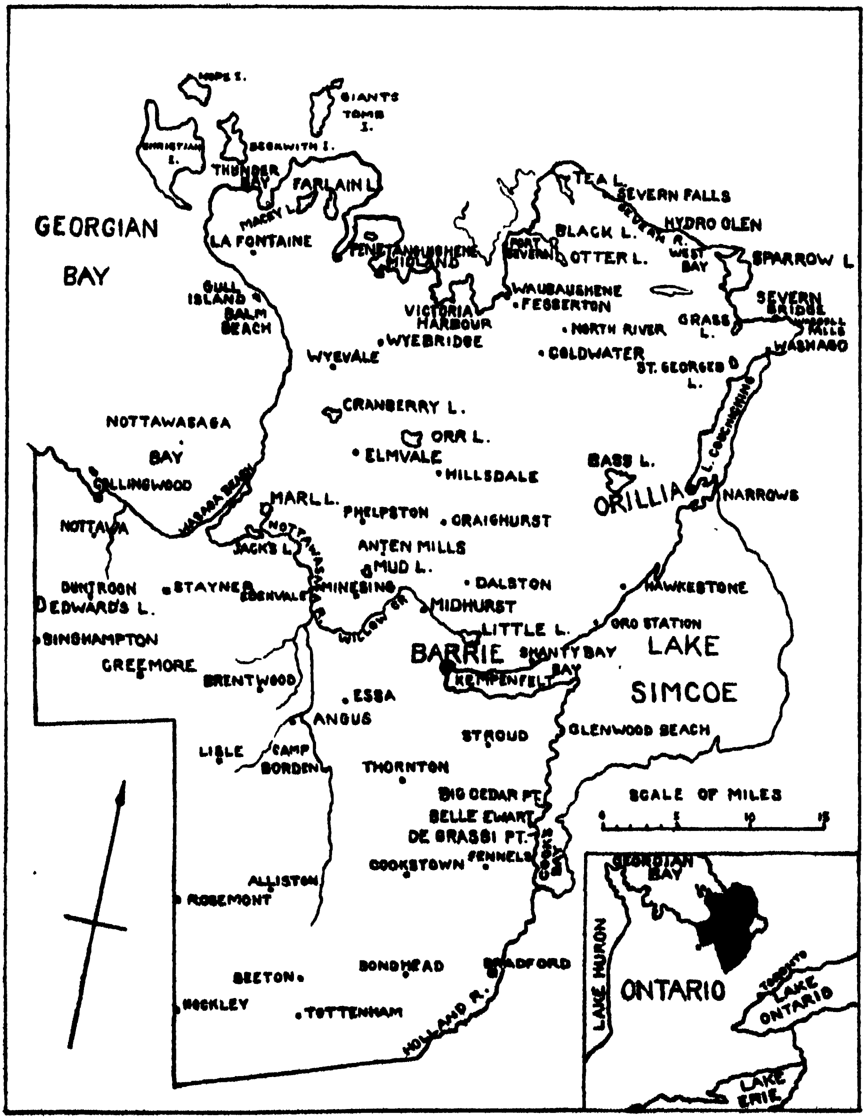
TOPOGRAPHY

In dealing with the bird life of any area it is advantageous to know something of its topography, vegetation and climate. These features have an influence on the distribution and abundance of its avifauna.

The general physical features of the county of Simcoe consist of a range of bold hills extending from the Blue Mountains at Collingwood in a southeastward curve into Nottawasaga township, then passing out of the county through Dufferin but coming in again across the extreme southwestern border of Adjala township. Another well defined chain extends from the southern part of Tecumseth township, parallels the shores of Lakes Simcoe and Couchiching and follows the Severn River westward. A branch of this chain diverges through the townships of Oro, Flos and Tiny and terminates as prominent headlands between Penetanguishene Bay and Christian Channel. Between these two ridges is the valley of the Nottawasaga River with its many tributaries. A number of the tributary streams such as the Mad and Noisy Rivers flow from the west and find their way through deep, picturesque gorges in the hills. The ridge of hills from Oro westward through Flos forms a dividing line between this valley and the region of small lakes to the north. These lakes are drained by streams flowing into Matchedash, Penetanguishene and intervening bays.

The underlying geological formation of the county as described by Beldon (1881) consists for the most part of rocks of the Silurian series, the one exception being at the north along the Severn River where Archaean rocks are exposed. These earlier and naturally lower formations of the Laurentian crystalline class have by some eruptive force been thrown to the surface and are to be found north of a line extending from Washago westward through Coldwater to Waubaushene. The territory here is broken and hilly with reddish, rounded rocks rising irregularly above the valleys which are generally occupied by a lake or are at least partly swampy. Over these rocks, as one passes southward, are the deposits of the Glacial and Post-Glacial periods of the Lower Silurian or Ordovician strata. In the western part of the county and ranging above the Ordovician are rocks of the Medina formation consisting chiefly of soft red sandstone along with some red and green shales. Above the Medina is the Niagara formation consisting of dark grey calcareous shales and limestone and forming the chief part of the Blue Mountains. With the exception of the small eruptive district at the extreme north, the county as a whole is essentially an agricultural area, approximately 700,000 acres, or 70 per cent., being improved for farming.

The presence of fresh-water shells in the post-glacial deposits indicate that at least part of the county was once under the waters of the great


HOPE I.
GIANTS TOMB I.
CHRISTIAN I.
BECKWITH I.
THUNDER BAY
FARLAIN L.
MACEY L.
GEORGIAN BAY
LA FONTAINE
PENETANGUISHENE
MIDLAND
GULL ISLAND
BALM BEACH
VICTORIA HARBOUR
WYEBRIDGE
WYEVALE
TEA L.
SEVERN FALLS
SEVERN R.
HYDRO GLEN
BLACK L.
PORT SEVERN
OTTER L.
WEST BAY
SPARROW L.
WAUBAUSHENE
FESSERTON
SEVERN BRIDGE
GRASS L.
NORTH RIVER
COLDWATER
WASHAGO
ST. GEORGES L.
CRANBERRY L.
ORR L.
ELMVALE
HILLSDALE
NOTTAWASAGA BAY
COLLINGWOOD
BASS L.
L. COUCHICHING
ORILLIA
NARROWS
MARL L.
PHELPSTON
CRAIGHURST
NOTTAWA
JACK'S L.
NOTTAWASAGA R.
ANTEN MILLS
MUD L.
DUNTROON
STAYNER
EDENVALE
MINESING
DALSTON
HAWKESTONE
EDWARD'S L.
WILLOW CR.
MIDHURST
ORO STATION
LITTLE L.
SINGHAMPTON
BARRIE
SHANTY BAY
LAKE SIMCOE
CREEMORE
BRENTWOOD
KEMPENFELT BAY
ESSA
ANGUS
LISLE
CAMP BORDEN
STROUD
GLENWOOD BEACH
THORNTON
BIG CEDAR PT.
SCALE OF MILES
0 5 10 15
BELLE EWART
DE GRASSI PT.
COOK'S BAY
COOKSTOWN
FENNELS
ALLISTON
ROSEMONT
BEETON
BONDHEAD
BRADFORD
HOCKLEY
TOTTENHAM
HOLLAND R.
GEORGIAN BAY
LAKE HURON
ONTARIO
TORONTO
LAKE ONTARIO
LAKE ERIE

post-glacial Lake Algonquin. The territory occupied by the townships of Flos, Sunnidale and parts of Essa, Tiny, Vespra and Nottawasaga, now forming the Algonquin lake plain, was once covered by this lake; the old beach is to be found along the ridge just north of Barrie. About the last spot to dry up sufficiently to permit tree growth was the black ash swamp of Minesing, now occupying some 20,000 acres. In the vicinity of Edenvale, the soil is of a slightly marly nature as the result of calcareous deposits in the form of the discarded shells of innumerable generations of tiny aquatic mollusks. At Marl Lake, in Flos township, there is a remarkably pure deposit of marl of great depth and chalky whiteness. Probably the most recently formed of all this terrain is the series of immense sand dunes lying parallel to Wasaga Beach in Flos and Sunnidale townships. Here, the receding lake waters attained their present shoreline on a tremendous glacial deposit of sandstone.

Along the southern boundary, the valley of the Holland River was once a bay of glacial Lake Algonquin. When the lake receded, this bay became an arm of Lake Simcoe. The gradual accumulation of sediments and aquatic vegetation caused it to fill up to the present marsh conditions. In 1927, over 7,000 acres of this marsh were reclaimed by means of dykes and drainage canals and brought under cultivation for market gardens (see Day, 1927).

Altitudes within Simcoe County range from 581 feet, the mean water level of Georgian Bay, up to 1700 feet near Singhampton in the Blue Mountains. The ancient Algonquin lake plain which covers the major central portion of the county has altitudes varying from 600 to 850 feet (see Putnam and Chapman, 1936). Bordering this plain are the Simcoe uplands which average 1,000 feet above sea level. Besides the Blue Mountains in Nottawasaga township, the only sections above 1,000 feet are a few small interlobate and drumlin areas in Adjala and Oro townships where altitudes occur up to 1,200 feet. Thus there is considerable variation in the terrain, from the level-to-undulating stretches of the Algonquin lake plain, the rolling character of the uplands, the hilly interlobate areas, and the almost mountainous escarpment.

The lakes of the county, which number approximately fifty, are mostly confined to that section lying north of Barrie. Lake Simcoe is the largest, followed by Lake Couchiching and Sparrow Lake. Of the smaller lakes, Bass, which covers about 1,200 acres, Orr and Little Lakes should be mentioned; others vary in size down to a few acres in extent.

Of the many rivers and streams found throughout the region, the most important are the Severn, Nottawasaga and Holland; those of lesser extent include the Wye, Coldwater, North and Sturgeon.

While much of the region is under cultivation there still remains a considerable area unsuited to agriculture and in a relatively untouched state. Few counties in Ontario are as well provided with such a variety of habitats favourable to the support of a varied bird life as is Simcoe County. Its many watercourses provide resting places for waterfowl during migration. Fine sandy beaches, notably along Wasaga Beach, afford excellent stopping-off places for many varieties of transient shorebirds during spring and fall. On several rocky islands in Georgian Bay Common Terns, Ring-billed Gulls and an occasional Herring Gull find conditions suitable for nesting. Extensive swamps at Minesing and Beeton, and many marshes, some of considerable size, such as those bordering the Holland River and Matchedash Bay, furnish excellent cover for marsh-dwelling birds.

FORESTS

The original forest has been mostly cut down with the clearing and settlement of the land and it is difficult to trace with accuracy the former tree associations and the comparative abundance of the various species. It is safe to say, however, that it was comprised of a mixture of hardwoods and conifers. Fairly extensive relict plots are still to be found in farm woodlots, along river-bottoms and in swampy or waste lands.

With the exception of the narrow belt at the extreme north, Simcoe County lies in the Huron-Ontario section of the Great Lakes-St. Lawrence Forest Region of Canada as classified by Halliday (1937). In this section at the present time the prevailing association is broad-leaved. Sugar maple and beech are dominant comprising about three-quarters of the forest. With them are basswood, white elm, yellow birch, white ash and some red maple and white oak. Small groups of hemlocks and balsam fir and an occasional white pine occur within the association, as well as a scattered distribution of large-toothed aspen, butternut and black cherry. On specialized sites such as river-bottoms and swamps, willow, blue beech, silver maple, slippery elm and black ash are found locally. White and red pine stands are found on lighter soils and were formerly more common, especially in northern townships. With the opening up of the county by railroads about 1850, commercial lumbering flourished and nearly all the pine had been taken out by 1890. Mixed associations of white pine and red oak are characteristic of certain shore sites along Georgian Bay, at Wasaga Beach, Penetanguishene, etc. (see Sharpe and Brodie, 1931). Eastern white cedar is present in swampy depressions. Almost pure stands of tamarack are still to be found along the border of the Holland Marsh and in other suitable low areas. Varying amounts of white spruce occur in favourable situations such as De Grassi Point where this species can be said to approach its southern limit.

The northern Precambrian section of the county above the Washago-Waubaushene line originally supported fine stands of white and red pine with a scattering of other species, but owing to lumbering and fire it now has a secondary association of poplar, white birch, large-toothed aspen, white and red pine and scattered red maple, elm, hemlock, balsam fir and white oak. Throughout this section, hardwoods occur on loamy slopes and on heavier soil deposits, while black spruce, tamarack and some cedar are to be found in depressions bordering lakes and swamps.

Among the more abundant shrubs and vines to be found are alder, hawthorn, sumach, service-berry, choke and pin cherry, round-leaved and red-osier dogwood, black and red-berried elder, sweet gale, red raspberry, huckleberry, climbing bittersweet, witch hazel and beaked hazelnut. The Common Juniper (*Juniperus communis* var. *depressa*) is established on the sand dunes bordering Georgian Bay and on the rocky banks along the Severn River.

Considerable reforesting is now being carried on in the county and many former waste areas have been replanted. The forestry experimental station and nursery is located at Midhurst, five miles north of Barrie, and there is a seed extracting plant at Angus.

CLIMATE

The generally higher altitudes prevailing within Simcoe County are geographical features which tend to give it a slightly cooler climate than the counties bordering on Lake Ontario, while the proximity of Georgian Bay undoubtedly exerts a tempering effect. Surrounding the county to a great extent is a 200-mile shoreline combining sandy beaches and shady woodlands with a profusion of lakes and bays. Within the last decade, the region has become internationally famous as an ideal place for summer residence owing to the moderate summer temperatures.

The climate of Simcoe County may be judged from the data given below for Barrie and Orillia, supplied by the Meteorological Service of the Department of Marine, Ottawa.

	Barrie	Orillia
Mean Annual Temperature	42.0°F.	43.0°F.
Mean Temperature, Dec.-Feb.	18.5°F.	18.3°F.
Mean Temperature, June-Aug.	65.3°F.	65.4°F.
Snowfall	100.7 in.	106.4 in.
Annual Precipitation	30.91 in.	32.15 in.

HISTORY OF SIMCOE COUNTY ORNITHOLOGY

An account dealing with Simcoe County would be incomplete without some mention of its rich historical background, especially since some of the early explorers have made reference to its wildlife in their published journals and writings.

Simcoe County, named after Upper Canada's first governor, was the land of the Huron Indians. For hundreds of years this nation lived in that part of the county lying between Orillia, Penetanguishene and the Blue Mountains. One of the earliest explorers to enter the Georgian Bay district was Samuel de Champlain who visited several Huron villages in 1615. The same year, Recollet Friars led by Father Le Caron established missions in the section that is now Tiny township. Father Gabriel Sagard, a member of this Order, spent the winter of 1623-24 among the Hurons and has given us a vivid account of the lives and customs of the natives and considerable natural history of the region in his several books, *Le Grand Voyage du pays des Hurons* and *Histoire du Canada*, printed in 1632 and 1636, respectively. An English translation of Sagard's *Grand Voyage* has been recently published by the Champlain Society (Wrong and Langton, 1939).

The Recollet Friars were replaced by the Jesuits about 1629 and members of this Order laboured among the Hurons for twenty years until the Iroquois incursions and massacres practically wiped out the Hurons and a number of the Jesuits. Accounts of their work among the Indians have come down to us in the form of *Relations* or reports written to their Superiors in Quebec and Europe (Thwaites, 1896-1901). In *Relation XI*, (1637, p. 7) Jean de Brebeuf says: "All thi regions abounds in game and fish." After the massacres, the survivors deserted the district, many going to Manitoulin Island, and the Jesuits finally abandoned the country in 1650.

When next we hear of the region it is occupied by Ojibway Indians, members of the Algonquin tribe. About 1778, fur traders began to drift in and trading-posts were established. In 1793, Governor Simcoe led an expedition into the county, passing by way of the Humber and Holland Rivers into Lake Simcoe and as far north as Penetanguishene Bay, for the purpose of exploring and naming the various bays and islands. Mr. Alexander Macdonell, who accompanied the expedition, kept a diary, since published by one of his descendants (Macdonell, 1890), in which are included occasional notes on natural history. A further reference to this expedition is to be found in *The Diary of Mrs. John Graves Simcoe* (Robinson, 1911).

Sir George Head, in his book, *Forest Scenes in the Wilds of North America* published in 1829, gives a vivid account of conditions as he found them in 1815 at Kempenfelt Bay and Penetanguishene. Included are many notes of interest to the naturalist.

Practically no settlement of the county took place until after the war of 1812-14. The first settlers were of Scotch origin and took up land along the Holland River in West Gwillimbury township in the year 1819. In this same year, some twelve families occupied land bordering the Penetanguishene road in Vespra and Oro townships. A marked influx of settlers took place in 1831, brought about to some extent by government land grants. From this year onward a continuous progressive development of the county can be said to have taken place.

Vivid recollections of the Passenger Pigeon and Bob-white near Craighurst about 1825 are given by The Reverend Thomas Williams in *Memories of a Pioneer* which first appeared in the Orillia *Packet* on November 28, 1890, and at intervals for about a year. These articles were later published in the *Pioneer Papers* by The Simcoe County Pioneer and Historical Society in 1908.

Sir John Richardson, eminent British scientist of the last century, travelled through the county en route to the Northwest in April, 1825. His journey took him across Lake Simcoe to Barrie and down the Nottawasaga River to Georgian Bay. A stop at Penetanguishene was of sufficient duration to enable him to collect a series of specimens. Notes concerning these birds were published in 1831 in *Fauna Boreali Americana*.

Samuel Thompson, who, in 1833, settled in the section that is now Sunnidale township, makes references to the Passenger Pigeon nesting in *Reminiscences of a Canadian Pioneer*, published in 1884.

In 1866, appeared a publication by H. B. Small entitled *The Canadian Handbook and Tourist's Guide*, in which mention is made of snipe-shooting at the Holland River. Instructions are also given on how to reach a "Pigeon Rookery" at Harrison's Crossing near Lefroy.

In an issue of *Forest and Stream* (1874), an account is given of a shooting expedition near Bradford, West Gwillimbury township. The article states that ". . . A shooting expedition organized at Bradford, Canada, last week consisted of two parties, with fifteen men in each. One returned with 3 foxes, 2 rabbits, 10 partridges, 1 hawk, 43 black squirrels, 5 woodpeckers, and 41 red squirrels, and the other with 8 grey squirrels, 4 partridges, 1 pigeon, 70 black squirrels, 4 blackbirds, 11 woodpeckers, 60 red squirrels . . . ."

RECENT ORNITHOLOGICAL WORK

In addition to the more or less historical accounts already mentioned, the earliest lists, so far as can be learned, dealing with Simcoe birds were those published in the *Transactions of the Canadian Institute* under the title, "Holland River Notes" by Thurston, Deacon and Atkinson (1892) and Atkinson (1892), in which are given the results of two hunting and collecting trips to the Holland River in 1890.

During the period 1890-1910, Mr. Archibald Debenham of Dalston made a collection of some two hundred local birds, most of which are mounted. He also contributed several short articles on birds to the *Family Herald* about 1912.

Mr. A. F. Young, former taxidermist of Penetanguishene, published in the *Ontario Natural Science Bulletin*, No. 1, 1905, "Bird Notes from Penetanguishene" which consisted of a short list of species seen locally. He also contributed many ornithological notes to the *Catalogue of Canadian Birds* (Macoun, 1904).

Dr. Paul Harrington, whose name appears frequently in this work, has spent practically every summer since 1913 in the South Georgian Bay region. An exceptionally keen field ornithologist, he has built up a fine oological collection from the county as well as published many accounts concerning its bird life in ornithological journals, among others being a list of fifty-six species of birds observed at Wasaga Beach in 1915 (Harrington, 1916). A paper entitled "Summer Birds of Wasaga Beach Vicinity" (unpublished) read by Dr. Harrington before the Toronto Ornithological Club, November 2, 1934, contained an annotated list of 154 species of which 104 had been found breeding. Dr. Harrington and James L. Baillie, Jr. collaborated in publishing *The Distribution of Breeding Birds in Ontario* (1936-37) in which appear many references to the nesting of birds in Simcoe County.

Dr. Frederic A. E. Starr of Sudbury has engaged in field work in the area and obtained considerable data on nests and eggs. His paper entitled "With the birds in the Georgian Bay District" published in the *Oologist* (1923) gives an annotated list of 47 species, most of them breeding.

Mr. H. Percy Bingham of Barrie has been an active field naturalist in the county since 1915. Besides acquiring a wealth of information on breeding birds of the region, he has formed a valuable oological collection. Since 1923 he has contributed a number of short articles to the *Oologist* on the breeding habits of local birds.

For many years Dr. Ewart L. Brereton of Barrie has been an active field ornithologist. Much of his leisure time has been devoted to the study of Simcoe birds and he has secured many rare and hitherto unrecorded specimens for the county. His voluminous notes on occurrence, migration and nesting have been of inestimable value to the writer. He has been a frequent contributor of short articles on birds to the Barrie *Examiner*.

Mr. Clarence B. Lawrence of Barrie has written several short notes on birds for the *Oologist* including an account of a visit to Gull Island, Georgian Bay. W. Melville (1892) recorded five species observed at Orillia. Mr. A. D. Henderson (1896) published on the breeding of two species at Little Lake, and has supplied the writer with a number of valuable records for this locality from 1894 to 1898. Fleming (1901) recorded two species seen at Washago; Snyder (1927 and 1931) and Baillie (1931 and 1936) have each reported on the occurrence of two species. Lincoln (1914 and 1927) has published a list of returns from banded birds in which are included nine records from Simcoe County. Christmas censuses of birds have been taken at Bradford by Devitt and Molony (1937); by Sutherland and Devitt (1938); and at Barrie by Brereton and Laws (1942). Other short articles relative to Simcoe birds have been published at various times by the writer in the *Canadian Field-Naturalist* and the *Auk* and further mention of these will be made under the species concerned.

Although the results of their work have not been published the following persons have made notable contributions to our knowledge of Simcoe ornithology: Mr. William Bush, former taxidermist of Coldwater and Fesserton; a Dr. Walker whose collection of 96 specimens of birds taken at Orillia during the period 1887-1889 is now in the R.O.M.Z.; Mr. William Green of Bradford whose collection of some 25 mounted birds, mostly ducks, taken at Holland River around 1900 has been presented to the Bradford High School; Mr. Samuel Barnes of Collingwood who has a collection of 90 mounted birds taken locally during the period 1910-1930; Mr. Holton B. Haugh, an active collector from 1915 to 1932 in the Little Lake area, whose collection of some 160 bird skins is now in the R.O.M.Z.; Messrs. L. L. Snyder, C. E. Hope and T. M. Shortt, members of the R.O.M.Z. survey party which visited the Penetanguishene area in June, 1935.

LIFE ZONES AND FAUNAL AREAS

The mixture of northern and southern species which characterize the County of Simcoe assign it to the Alleghanian faunal area of the Transition life zone. Snyder (1938) has stated that the fauna of this area reaches its purest condition in the Lake Simcoe region. Since the term Transition indicates a mixture of forms from adjacent zones, a number of southern species here find their northern limits and a number of northern species here find their southern limits. In support of the existence of these conditions in the county, we find such Carolinian forms of the Austral life zone as the Field Sparrow (*Spizella pusilla*) and Henslow's Sparrow (*Passerherbulus henslowi*) occurring side by side with such characteristic Canadian zone species as the White-throated Sparrow (*Zonotrichia albicollis*), Nashville Warbler (*Vermivora ruficapilla*) and Olive-sided Flycatcher (*Nuttallornis mesoleucus*).

Mention of the overlapping of range of forms having a centre of abundance to the north and to the south is more convincingly indicative of the Transition zone than is a selection of specific indicators. However, it is generally agreed by other writers that several bird species are characteristic of this zone, namely, the Bobolink (*Dolichonyx oryzivorus*), Wilson's Thrush (*Hylocichla fuscescens*) and the Black-billed Cuckoo (*Coccyzus erythrophthalmus*). This selection is consistent with our findings in this county.

MODERN CHANGES IN THE BIRD LIFE

The advent of the pioneer and the subsequent clearing of the land has undoubtedly had a marked influence on the bird life of the county. The cutting down of the trees and the changes that come with settlement have eliminated a number of species which normally find in the forest essentials to their existence.

Although early accounts are rather meagre, it seems reasonable to believe that such forest-loving species as the Wild Turkey, Spruce Grouse and Pileated Woodpecker were formerly fairly common in the region. The Passenger Pigeon was abundant and waterfowl much more plentiful than at the present time. However, there is no reason to believe that the sum-total of bird life is much less now than it was a century and a half ago. Field-inhabiting birds such as the Prairie Horned Lark, Bobolink, Meadowlark, Savannah and Vesper Sparrows in all probability have increased markedly. Houses and farm buildings have provided numerous nesting-sites for Robins, Martins, Phoebes, Chimney Swifts, Barn and Cliff Swallows and contributed to their increase. The English Sparrow, Starling, Common Pheasant and European Partridge have been introduced and the first two have increased tremendously; probably the Starling is now the most abundant bird in the county. Of quite recent origin has been the advent of such species as the Cardinal, Leconte's, Henslow's and Grasshopper Sparrows.

MIGRATION

The migratory movement of birds is a well-known and fascinating phenomenon of bird life. Each spring waves of migrants pass through the county during April and May; some may stop off to spend the summer while others journey on to distant breeding grounds in the north. The months of September and October find these birds and their young passing southward en route to winter homes. Two well-travelled flyways are known to exist in Simcoe County, one of which is along the Holland River and around Lake Simcoe; and the other is around the shore of Nottawasaga Bay. In spring, a marked migratory flight takes a generally northeasterly course around this bay; the direction is reversed in the fall. In these twice yearly journeys birds are subjected to many dangers and considerable numbers are destroyed by storms and predators. Lighthouses also take some toll. In this connection Lewis (1927) states that "In Ontario, about 70% of the flashing, revolving, and occulting white lights are not seriously destructive to bird life, but the remaining 30% cause the death of from 100 to more than 500 birds at each light each year." The destructiveness of a given light appears to be chiefly dependent on its situation. In Simcoe County no serious destruction of bird life by lighthouses has been reported. At the Hope Island light, only 7 birds were reported killed in 7 years and these all on one rainy spring night, and at the Giant's Tomb Island light, 8 (in length of time not stated) during rainy spring evenings (Lewis, loc. cit.).

In the annotated list of birds an attempt has been made to record, where known, the average spring arrival date and the earliest arrival date for the various species.

ACKNOWLEDGMENTS

In the preparation of this account considerable ornithological information has been placed at the writer's disposal by the following persons and this aid is here gratefully acknowledged: Mr. S. H. Henry of Toronto for use of notes on migration made during residence at Collingwood and Barrie from 1913 to 1918; Mr. F. E. Courtice for information on bird arrival dates at Collingwood since 1912; Dr. Ewart L. Brereton for many valuable notes and specimens; Dr. Paul Harrington for submitting data on nests and eggs, and for giving the writer access to his unpublished manuscript; Mr. H. P. Bingham for many breeding records; and Mr. H. H. Southam for bird-banding records.

Local lists, specimens or field notes have also been received from the following persons: Messrs. Nicol Anderson, Little Lake; J. L. Baillie, Jr., Toronto; J. J. Baker, Toronto; S. Barnes, Collingwood; L. H. Beamer, Meaford; G. D. Buie, Stayner; D. Butler, Barrie; F. S. Cook, Toronto; W. V. Crich, Toronto; C. L. Dawson, Waubaushene; S. C. Downing, Toronto; J. H. Fleming, Toronto; W. W. H. Gunn, Toronto; J. C. Hall, Toronto; H. B. Haugh, Little Lake; A. D. Henderson, Belvedere, Alta; Dr. and Mrs. G. E. Hobbs, London; Messrs. C. E.

Hope, Toronto; E. R. Hunter, Toronto; G. Lambert, Toronto; R. V. Lindsay, Toronto; D. S. Miller, Toronto; G. H. Moase, Atherley; C. E. Molony, Toronto; G. H. Richardson, Toronto; Major Mark Robinson, Barrie; K. Rose, Fesserton; R. J. Rutter, Toronto; Dr. R. M. Saunders, Toronto; Messrs. D. M. Scott, Montreal; R. A. Smith, Newmarket; W. W. Smith, Toronto; J. M. Speirs, Ancaster; Donald Sutherland, Bradford; G. C. Toner, Toronto; S. Troyer, Oakridges; T. Twiss, Barrie; R. D. Ussher, King; Dr. E. M. Walker, Toronto.

The writer wishes especially to express his thanks to the members of the staff of thè Royal Ontario Museum of Zoology, and in particular to Mr. L. L. Snyder and Mr. J. L. Baillie, Jr., for their checking of the manuscript and for many helpful suggestions. Our thanks are also due to Mr. David Sutherland on whose property the camp at Holland River was established.

ANNOTATED LIST

In the following list of birds known to occur in Simcoe County, the writer has made use of considerable information from the published literature and from notes and unpublished manuscripts kindly furnished by many observers in addition to personal notes and observations. Besides this material, specimens in many private collections have been carefully examined and the collection and records in the Royal Ontario Museum of Zoology (R.O.M.Z.) have been freely consulted.

The list here presented totals 257 species of birds. Five additional species are considered of hypothetical occurrence for lack of positive information. A total of 136 species have been known to breed in the county. The great majority of the species (236) included in the list are based on specimens collected and a few are admitted upon satisfactory sight evidence.

The common and scientific names used correspond to those given in *Birds of Canada* by P. A. Taverner, 1934. The systematic order of the species followed is that of the 1931 edition of the American Ornithologists' Union *Check-List of North American Birds.*

The use of specific nomenclature has been adopted practically throughout the list. Subspecific names have been used only where sufficient specimen material was available for positive determination or where subspecific validity seemed justified on geographical grounds.

Following the general account of each species there appears a list of specimens and where definitely known the sex of each is indicated by the symbol ♂ for male and ♀ for female. Unless otherwise stated the specimen is in the writer's collection. Specimens followed by an asterisk (*) are in the collection of the Royal Ontario Museum of Zoology.

1. **Common Loon.** *Gavia immer.*—A fairly common spring and fall transient and uncommon summer resident; breeds. The opening of the waterways about the third week of April heralds the arrival of the loon with its weird, laughing calls. In the fall, they sometimes congregate in large, loose flocks preparatory to migrating. On October 20, 1934, over 100 birds were counted along a front of three miles off Wasaga Beach; and Dr. E. L. Brereton noted 74 on Kempenfelt Bay on November 17, 1938. An historic record is given by Head (1829), who mentions observing loons at Kempenfelt Bay on May 25, 1815.

The Common Loon has no doubt suffered from the encroachments of civilization, being now restricted as a breeding bird to the less frequented lakes and islands of the county. It has been reported nesting at Little Lake, Barrie, on July 10, 1895, by Henderson (1896). A set of two eggs taken there by H. B. Haugh on May 25, 1918, has been recorded by Baillie and Harrington (1936). Mr. H. P. Bingham located nests at Little Lake on June 10, 1931; June 26, 1932; and June 18, 1933. During the summer of 1932, Mr. H. Gillis found a nest with two eggs at Simcoeside Beach, near Hawkestone, and later saw the young. A nest observed by the writer on June 16, 1938, was situated on a small island in Tea Lake, Matchedash township.

According to Lincoln (1924), a Common Loon which was banded by H. A. McGraw at Altoona, Pennsylvania, on April 30, 1923, was discovered dead on May 27, 1923, at Balm Beach, Simcoe County. Two specimens found dead at Wasaga Beach on May 6, 1934, bore evidence of having been caught in fish-nets. Mr. Jack Mawson reported that on July 14, 1938, fishermen caught two Common Loons in gill nets set in eight fathoms of water (48 feet) in Nottawasaga Bay off Craigleith.

Average date of spring arrival (7 years), April 22 (Barrie); earliest, March 31, 1935 (Wasaga Beach).

♂ June 21, 1918, Little Lake.*
♂ May 21, 1932, Wasaga Beach.*
♂ May 6, 1934, Wasaga Beach.

2. **Red-throated Loon.** *Gavia stellata.*—An uncommon transient. While this species may be more regular as a migrant than the present records would seem to indicate, its presence in the county has been detected on but few occasions. On October 11, 1929, Dr. A. J. Harrington shot a female at Wasaga Beach; the specimen is now in the R.O.M.Z. On March 7, 1938, the R.O.M.Z. received a Red-throated Loon from Mr. David Haig of Midland. This bird, in typical winter plumage, was found alive at Wyebridge where it had apparently come down on the ice and was unable to rise again. On September 18, 1938, four birds were observed by the writer to good advantage, with the aid of 8-power

binoculars in Collingwood harbour. A specimen found dead at Wasaga Beach on October 4, 1941, by Dr. Brereton was later examined by the writer but not preserved.

♀ October 11, 1929, Wasaga Beach.* ? March 7, 1938, Wyebridge.*

3. **Red-necked Grebe.** *Colymbus grisegena.*—An uncommon spring and fairly common fall transient. A single bird was observed at the mouth of the Nottawasaga River on April 26, 1936; and three birds were reported there by Dr. P. Harrington on September 29, 1928. Mr. W. W. Gunn saw one in Collingwood harbour on May 4, 1938. Dr. Brereton, Mr. D. S. Miller and the writer noted an individual in breeding plumage at Little Lake on April 30, 1939. A favourite resting place for these birds in the fall is Kempenfelt Bay, where they occasionally congregate in flocks of considerable size. Thirty-five were present on October 18, 1939, and Dr. Brereton has recorded individuals there as late as December 13 (1940). An interesting summer occurrence concerns two birds noted by Mr. J. L. Baillie at Barrie on July 19, 1943.

A winter-plumaged specimen, taken at Dalston about 1900, is in the Debenham collection. Mr. S. Barnes has a specimen which was shot at Collingwood about 1915. A male collected at Orillia on June 6, 1902, is in the Dwight collection (No. 17-385) in the American Museum of Natural History.

Average date of spring arrival (6 years), April 22 (Barrie); earliest, April 17, 1941 (Barrie).

? April 19, 1915, Barrie.* ♀ April 27, 1930, Little Lake.*

4. **Horned Grebe.** *Colymbus auritus.*—A common spring and fall transient. This grebe is to be found frequenting the shallower waters of bays and harbours where its favourite food is prevalent. It usually arrives about the middle of April, and is present until about the first week of May. A female specimen secured at Angus by Dr. E. L. Brereton on March 16, 1943, marks its earliest spring occurrence. Fall migrants appear about September 10, and are common until mid-November. On October 30, 1938, 15 birds were counted in Collingwood harbour. At Kempenfelt Bay, Dr. Brereton reported 10 birds on November 4, 1939, and has recorded individuals as late as November 17 (1938).

A Horned Grebe shot at the mouth of the Holland River on October 22, 1890, has been recorded by Atkinson (1892). A specimen taken at Orillia by Dr. Walker on September 10, 1887, is in the R.O.M.Z.

Average date of spring arrival (7 years), April 19 (Barrie).

? September 10, 1887, Orillia.*
♀ November 7, 1925, Shanty Bay.*
♀ October 23, 1932, DeGrassi Point.*
♂ May 9, 1939, Little Lake.
♀ March 16, 1943, Angus.

6. **Pied-billed Grebe.** *Podilymbus podiceps.*—A common spring and fall transient and summer resident; breeds. This small grebe prefers shallow, reedy lakes or ponds. Its nest is built on a floating platform of marsh vegetation. In suitable areas, such as at Matchedash Bay, it breeds abundantly; 17 nests containing from one to eight eggs were found there on June 16, 1939, by Mr. F. S. Cook and the writer. The finding of six nests at Little Lake is recorded by Henderson (1896); and sets taken there by H. P. Bingham and H. B. Haugh have been noted by Baillie and Harrington (1936). The earliest nest reported is one of seven eggs found on May 15, 1938, by Mr. Bingham at Little Lake. At Holland River, near Bradford, R. D. Ussher (1939) saw four adults and four young on July 7, 1939. Two nests, with eight and three eggs, respectively, were found at Marl Lake on June 6, 1929, by Dr. Harrington. Adults and three large young were observed by the writer in a marsh at Orillia Narrows on June 11, 1941.

Dr. Brereton has noted this species at Little Lake as late as October 11 (1941), on which occasion six individuals were recorded.

Average date of spring arrival (5 years), April 13 (Barrie); earliest, April 3, 1938 (Barrie).

♀ September 15, 1934, Bradford.
Juv. ? June 16, 1939, Waubaushene.

6. **White Pelican.** *Pelecanus erythrorhynchos.*—An accidental visitant from the west; one record. One was shot at Victoria Harbour by Mr. W. N. Ball in October, 1930. According to an account by Lorne A. Ball which appeared in the Toronto *Mail and Empire* under date of October 27, 1930, "the bird was shot by W. N. Ball, Victoria Harbour, veteran fisherman and hunter, who was alone in his boat. After a chase lasting more than an hour, a very excellent shot by Mr. Ball bagged the prize as the bird was leaving the water, about 400 yards from the dock at Victoria Harbour . . . it is the firm belief of local sportsmen that there is still another bird in the vicinity as a similar bird had been seen the same morning Mr. Ball got his." The specimen was mounted by Mr. W. Sutherland and is now on display in the Palmer House, Orillia.

7. **Double-crested Cormorant.** *Phalacrocorax auritus.*—A rather rare spring and casual fall transient. A specimen in the Barnes collection

was shot at Collingwood harbour about 1900 by Mr. A. Lavers. In the fall of 1916, one was secured from a small flock at Orr Lake by Mr. H. Greenwood and the mounted specimen is now in the possession of Mr. H. Williams of Barrie. A specimen taken on November 2, 1931, at Little Lake by Mr. H. B. Haugh is in the R.O.M.Z. Mr. C. L. Dawson reports having shot one at Waubaushene on September 15, 1937. He considers it to be a rare visitor there. Dr. E. L. Brereton has recorded it twice at Kempenfelt Bay, Barrie; three on June 3, 1941 and an individual on May 12, 1943. A single bird was observed by Mr. J. L. Baillie and Dr. P. Harrington at Wasaga Beach on October 1, 1927. Dr. Harrington reports that he has occasionally noted them there during the fall hunting season and saw one shot at the mouth of the Nottawasaga River on October 4, 1924. Two individuals were seen on Kempenfelt Bay on September 23, 1939, by Dr. Brereton and the writer, and two others by Dr. Brereton on October 2, 1941.

♂ November 2, 1931, Little Lake.*

8. **Great Blue Heron.** *Ardea herodias.*—A common spring and fall transient and summer resident; breeds. This is one of the earliest species to return in the spring. On March 31, 1935, a bird was observed flying over the frozen surface of Marl Lake, and two were seen resting on the ice barrier at the mouth of the Nottawasaga River on April 16, 1939. It has been recorded at Barrie as late as November 29 (1938).

A large breeding colony is located in the heart of the Minesing Swamp, near the junction of Willow Creek and the Nottawasaga River. The nests are built in large black ash and silver maples at heights of fifty feet or more. This colony has been in existence for at least fifty years, and Mr. A. D. Henderson informed the writer that he collected several sets of eggs there on April 28, 1898. It has increased from 50 nests in 1925, when it was visited by Baillie and Harrington (1936), to approximately 90 nests as counted by the writer in 1938. Bingham (1926) reported having secured four sets of eggs on May 14, 1926, and the same observer found incubation advanced in a set of six eggs examined on May 1, 1938. Birds from this colony range far and wide over the county, it being not unusual for one to fly 20 miles to a favourite stream to fish. Individuals observed in the Orillia and Washago areas are probably wanderers from the large colony on Thorah Island, Lake Simcoe, which is just outside the limits of the county. On June 16, 1938, six birds were noted flying over Tea Lake in a westerly direction, indicating the possible existence of another colony in the northern section of the county.

A mounted specimen, now in the Bradford High School, was taken at Holland River by Mr. William Green about 1900. One taken at Dalston about 1910 is in the Debenham Collection.

Average date of spring arrival (7 years), April 10 (Barrie).

9. **Great White Egret.** *Casmerodius albus.*—An accidental visitant. On April 30, 1908, one was taken at Kean's Creek, foot of West Street, Orillia by Mr. W. Sutherland, former taxidermist of that town. This beautifully mounted specimen, adorned with 42 graceful, flowing "aigrette" plumes was seen and reported on by the writer (Devitt, 1936).

According to Mr. George White, local fisherman, a "white heron" about the size of a Great Blue had been present at "the shoals" near Collingwood for two weeks during August, 1930. More recently, one that remained near the mouth of the Holland River, Cook's Bay, for a month during August and September, 1936, was observed by the writer on September 13.

10. **Little Blue Heron.** *Florida caerulea.*—An accidental visitant. The only record of occurrence of this species within the borders of the county is that of an immature (white phase) taken in a muskrat trap by Mr. George Moase, at Atherley Narrows between Lakes Simcoe and Couchiching, on March 28, 1929. The bird was turned over to Mr. Peter Stevenson, District Superintendent of the Department of Game and Fisheries, at Orillia, who had it mounted and sent to the Department at Toronto where it was identified and reported on by J. L. Baillie (1931). The specimen is now in the collection of the R.O.M.Z. Mr. Moase informs the writer by letter that "the bird was caught at the entrance to Lake Couchiching on the west side of the channel, in Simcoe County." This appears to be the most northerly record for the species in Ontario.

Imm. March 28, 1929, Atherley Narrows.*

11. **Green Heron.** *Butorides virescens.*—An uncommon spring and fall transient, and an uncommon summer resident in the southern half of the county; breeds. The Green Heron apparently reaches the northern limits of its breeding range in the latitude of Barrie. A nest containing five eggs was discovered by Mr. H. P. Bingham in a dense alder growth at Little Lake on June 23, 1935. In the same locality on May 26, 1940, Mr. Raymond Hill picked up three hatched egg shells which were identified at the R.O.M.Z. as belonging to this species. A search made of the immediate vicinity failed to reveal any nest, suggesting that the heron may have carried the shells some distance before

dropping them. Dr. Brereton saw an immature at Little Lake on July 29, 1939, and two adults and two immatures at Dyment's Pond, Barrie, on August 4, 1939. A set of four eggs found at Big Cedar Point by Mr. W. W. Smith on May 25, 1935, is in the writer's collection. Within recent years it has been found during the breeding season at Holland River, Gilford, Batteaux Creek, and Marl Lake. Our latest autumn date is September 24 (1939), when three individuals were observed at Barrie. A specimen in the writer's collection was secured at the Nottawasaga River, near Minesing Swamp by Mr. J. Goslin on June 1, 1925.

Average date of spring arrival (6 years), May 11 (Barrie); earliest, April 23, 1941 (Barrie).

♂ September 3, 1892, Cookstown.*
♂ September 9, 1930, Little Lake.*
? June 1, 1925, Nottawasaga River, Minesing Swamp.

12. **Black-crowned Night Heron.** *Nycticorax nycticorax.*—A rare spring and summer visitant. This species has been detected on a few occasions in summer but no nesting evidence has been discovered.

Fleming (1901) recorded having seen one at Washago in May, 1899. An adult was observed near Bradford by Dr. F. A. E. Starr on June 22, 1921; and Snyder and Baillie reported seeing an adult along the upper Holland River on June 29, 1926 (Snyder, 1930). An immature was shot by Mr. H. B. Haugh on September 11, 1925, at Little Lake. Unfortunately, this mounted specimen was later destroyed by fire. On September 2, 1935, an immature was observed by the writer at the mouth of Batteaux Creek. More recent records concern seven individuals reported at the Holland River Marsh on May 27, 1941, by Mr. Donald McDonald and Mr. John MacArthur, and two birds observed in the same locality on September 13, 1942, by members of the Toronto Ornithological Club.

13. **American Bittern.** *Botaurus lentiginosus.*—A common summer resident; breeds where marshy conditions are favourable. Perhaps this bird is more often heard than seen. Its peculiar "pumping" notes are characteristic sounds to be heard from any but our smallest marshes.

Nests found at Collingwood in 1928, at Orr Lake, Marl Lake and Mac, in 1929, have been recorded by Baillie and Harrington (1936). At De Grassi Point, young were seen on August 4, 1936, by Mr. E. R. Hunter and Dr. E. M. Walker. A nest with four eggs was found by the writer in the Holland Marsh, near Bradford on June 12, 1939. In the marshes bordering Matchedash Bay, Mr. F. S. Cook and the writer found it to be quite common on June 16, 1939; eleven birds were noted (eight near Fesserton), and a nest containing three eggs discovered at Waubaushene. On July 15, 1939, an adult and two young, with down still adhering to the crown, were seen by the writer in a small, swampy marsh three miles south of Brentwood.

Average date of spring arrival (5 years), April 29 (Barrie); earliest, April 20, 1938 (Little Lake); latest, October 9, 1939 (Collingwood).

? September 9, 1930, Little Lake.*

14. **Least Bittern.** *Ixobrychus exilis.*—A fairly common summer resident; breeds. This little bittern inhabits many of our marshes but is rather locally distributed. Fleming (1901) records having seen one at Washago in May, 1899. In his account of the *North American Marsh Birds*, A. C. Bent (1926) gives Coldwater and Ewart (Belle Ewart) as localities which mark the northern limit of its breeding range. Baillie and Harrington (1936) recorded a colony of six pairs at Marl Lake on June 6, 1929. Other nests have been found there by the writer on July 2, 1934 and June 13, 1939. It breeds regularly at Little Lake. A nest found there on June 22, 1939, contained four eggs; and sets taken by Mr. H. B. Haugh and Mr. H. P. Bingham on June 4, 1915, and June 16, 1925, respectively, are in the R.O.M.Z. A nest containing five eggs was observed by the writer on June 16, 1935, at Otter Lake, Matchedash township. At Holland Marsh, Bradford, a nest with four young was shown to me by Mr. W. V. Crich on June 18, 1938.

A mounted specimen in the Bradford High School was shot at Holland River by Mr. W. Green about 1900. Mr. Barnes has two mounted specimens taken at Collingwood about 1920.

An individual observed at the Holland Marsh by Messrs. J. L. Baillie and J. Crosby on September 13, 1942, constitutes our latest autumn occurrence record.

? ——— 1912, Bradford.* ♀ July 19, 1930, Little Lake.*

15. **Whistling Swan.** *Cygnus columbianus.*—A rare transient. A letter on file in the R.O.M.Z. from Mr. Joseph Park, former resident of Bradford, under date of February 13, 1908, states that "a swan was caught about two months since (December, 1907) by a farmer named O'Donnell living near the mouth of the Holland River. It seems there were five of them and they had been circling around sometime before they alighted." In his notes, the late Mr. J. H. Fleming mentions the occurrence of swans at the mouth of the Holland River, Cook's Bay, in November and December, 1907.

An individual was observed by Messrs R. A. Smith, C. E. Molony and the writer at Orr Lake on March 31, 1935. Mr. Kenneth Rose of Fesserton informs me that four swans remained in Matchedash Bay for several weeks in late April, 1938. A flock of four swans was observed by Mr. E. Durkin on November 19, 1940, in Nottawasaga Bay off Craigleith.

16. **Canada Goose.** *Branta canadensis.*—A common spring and fall transient. Sagard, writing of the wildlife of the region in 1624, says: ". . . likewise bustards or wild geese, which they call *Ahonque*, for there are plenty of them in the country." (Wrong and Langton, 1939). Another account (Le Jeune, 1637, 13:255) tells of four "bustards" being killed. Head (1829) mentions seeing "a great many flights of geese" in late March, 1815, at Kempenfelt Bay. Atkinson (1892) records flocks of geese passing over Holland River on October 20 and 28, 1890.

Flocks appear early in April, often before the smaller lakes are free of ice. At this season, many are to be seen frequenting the waters of Nottawasaga Bay where they appear to rest for a time before resuming their journey to the north. Flocks of 15, 25, 42 and 75 birds were counted there on April 18, 1935. Mr. C. E. Molony and the writer watched a noisy flock of 60 geese come winging in from the south and alight in an open lead in the ice at the mouth of the Nottawasaga River on April 16, 1939. Another favourite resting place is at Gull Rock, near Oro Beach, Lake Simcoe, where 180 birds were observed by Mr. D. S. Miller on May 2, 1938. A lone individual was observed at Marl Lake on June 4, 1939. When approached it was able to fly quite well and to all appearances was a wild bird.

The main fall flights take place during the period from October 15 to 30. A flock of 35 birds was encountered at Orr Lake on November 11, 1942, by Dr. Brereton. A specimen shot at Wasaga Beach on October 17, 1937, and examined by the writer was clearly referable to the race *Branta canadensis canadensis.*

Average date of spring arrival (11 years), April 12 (Collingwood); earliest, March 15, 1938 (Barrie).

17. **Common Brant.** *Branta bernicla.*—A rare spring and fall transient. While duck hunting at One Tree Island, near the mouth of Batteaux Creek in 1910, Mr. Samuel Barnes saw an odd bird pitch in among his decoys. Realizing that it was unusual, he collected it and had it mounted. The writer had the privilege of examining the specimen in 1939, identifying it as a White-bellied Brant *Branta bernicla hrota.*

Mr. Kenneth Rose of Fesserton informs me that several were shot by hunters at Matchedash Bay during the fall of 1938. Mr. H. B. Haugh saw 24 birds at Little Lake about 1938, and Mr. H. P. Bingham reported three individuals there on May 3, 1941. Four birds were observed off Craigleith on November 8, 1940, by Mr. Leslie Hart of Meaford. A single specimen was secured and is now in the R.O.M.Z.

? November 8, 1940, Nottawasaga Bay.*

18. **Snow Goose.** *Chen hyperborea.*—An irregular transient; sometimes occurs in numbers in the fall. Mr. H. B. Haugh shot one from a flock of ten at Little Lake on October 17, 1926. Mr. F. Welch saw two at Fesserton on October 21, 1933, and secured a specimen which is in the R.O.M.Z.

A report appearing in the Toronto *Evening Telegram* of November 7, 1934, stated: "Snow Geese or Waveys are reported in Georgian Bay this fall . . . . There was a flock of 600 birds near Midland." During the week of October 30, 1934, a great storm on Georgian Bay forced large numbers to seek shelter of the land at Wasaga Beach. Literally hundreds appeared along ten miles of beach and many were shot by local hunters.

Mr. L. H. Beamer reported seven at Wasaga Beach on May 1, 1936; and migrating flocks of 75, 9 and 50 were observed there by the writer on October 12, 15 and 16, 1936, respectively. Five were seen off Gull Rock, Lake Simcoe, by Mr. D. S. Miller on May 2, 1938. A flock of 75 appeared at the mouth of the Nottawasaga River on October 20, 1938, according to Mr. R. Eberhardt. A single white individual, swimming with a flock of Canada Geese, was observed by Mrs. J. Miller off Oro Beach on April 30, 1940.

Specimens examined are referable to the Lesser Snow Goose *Chen hyperborea hyperborea.*

♂ October 21, 1933, Fesserton.* Imm.? October 12, 1936, Wasaga Beach.

19. **Blue Goose.** *Chen caerulescens.*—An uncommon spring and fall transient. On November 11, 1934, an immature specimen was found dead by the writer at Wasaga Beach. Lead pellets in the wing bore evidence that it had been shot. Another immature was located under similar circumstances on October 13, 1936. One was shot from a flock of eight, two miles north of Thornton on October 24, 1936; the specimen was sent to the R.O.M.Z. by Mr. M. W. Curtis of Cookstown. Mr. L. H. Beamer reported eleven at Wasaga Beach on November 4, 1936. Off Gull Rock, Lake Simcoe, on May 2, 1938, Mr. D. S. Miller examined one at close range in a flock of Snow Geese. At Orr Lake on November 11, 1942, Dr. Brereton noted seven Blue Geese in a flock of Canada Geese.

Imm. ? November 11, 1934, Wasaga Beach. ? October 24, 1936, Thornton.*

20. **Mallard Duck.** *Anas platyrhynchos.*—A regular spring and fall transient, uncommon summer resident and rare winter visitant; breeds sparingly. Pairs which were probably breeding have been noted in Minesing Swamp by Mr. J. L. Baillie on May 22, 1932; by the writer on May 15, 1938; by Mr. A. Helmsley on May 21, 1938; and Dr. Brereton saw a female at Willow Creek on June 28, 1941. Mr. C. L. Dawson of Waubaushene informed me that this species breeds in the Matchedash Bay marsh and that on several occasions he had caught the young. Mr. F. S. Cook and the writer saw a male and two females flying about this marsh, near Fesserton, on June 16, 1939.

The largest fall flights occur between September 25 and November 1. Five individuals were noted on October 3, 1937, at Wasaga Beach. A flock of ten was seen by Mr. W. W. Gunn on September 27, 1938, in a flooded field near Elmvale. Atkinson (1892) reported shooting one at the mouth of the Holland River, October 25, 1890. A male specimen in the writer's collection was shot near Barrie by Mr. Vernon Hook on October 31, 1939. Mr. Nicol Anderson has two mounted specimens taken at Little Lake about 1924. An individual, in company with three Black Ducks, was seen by Dr. Brereton on February 1, 1941, at Hewitt's Creek, near Barrie.

Average date of spring arrival (4 years), April 18 (Barrie).

♂ October 31, 1939, Vespra township, near Barrie.

21. **Black Duck.** *Anas rubripes.*—A common spring and fall transient and a fairly common summer resident; rare winter visitant. Head (1829) writes concerning it at Kempenfelt Bay: "On April 20 (1815) I went out in quest of wild fowl and shot several; among them a species of black duck." Atkinson (1892) secured specimens at Holland River on October 22, 1890. Occasional birds have been reported during the winter: Mr. A. F. Young (Klugh, 1905) saw two near Penetanguishene on February 8, 1905; Mr. H. B. Haugh collected two specimens at Little Lake on March 9, 1930; and Dr. E. L. Brereton saw three on a small open creek near Barrie on February 1, 1941. Mr. W. W. Gunn witnessed a flock of over one hundred birds in a marshy field near Elmvale on September 27, 1938.

This is our commonest nesting duck, being well distributed in summer from Holland River to Tea Lake and Giant's Tomb Island. Breeding records are numerous: nests with eggs have been found as early as May 9, and young are usually in evidence about the first week of June. On May 27, 1922, a nest with eight eggs was found by the writer on Nancy Island in the Nottawasaga River; Mr. J. L. Baillie saw three families of young in Minesing Swamp on June 7, 1928; Dr. P. Harrington noted eight downy young at Orr Lake on June 7, 1929; Mr. H. P. Bingham located a nest with eleven eggs at little lake on May 9, 1937; and Mr. J. J. Baker found a nest containing eight eggs at Big Cedar Point, Lake Simcoe, on May 24, 1937. Mr. C. L. Dawson informs me that they breed regularly in the Matchedash Bay marsh, near Waubaushene.

Five records of Black Ducks banded at Lake Scugog by H. S. Osler and recovered in various parts of Simcoe County have been reported by Lincoln (1924 and 1927). A Black Duck banded at Lake Scugog on October 8, 1923, was shot on Christian Island on October 20, 1929 (Can. Field-Nat., Feb., 1931, p. 44).

Average date of spring arrival (11 years), April 13 (Collingwood).

Juv. ♀ June 7, 1928, Minesing.* ♂ September 15, 1934, Bradford.*
2 ♂♂ March 9, 1930, Little Lake.*

22. **Gadwall.** *Chaulelasmus streperus.*—A very rare transient. The only record for the county is that of one seen at Kempenfelt Bay, Barrie, by Dr. E. L. Brereton from December 13 to 15, 1940. Ample opportunity was afforded for careful study since the bird permitted close approach, once within 40 yards. Comparison to descriptions and plates left no doubt that it was a Gadwall in female plumage.

23. **European Widgeon.** *Mareca penelope.*—An accidental visitant. This old-world species has been recorded on two occasions. On April 26, 1942, Messrs. J. L. Baillie, T. Murray, Dr. R. M. Saunders and the writer observed an individual in male plumage in a group of eight Baldpates at McLean's Pond near Little Lake. This bird remained at the pond for several days and was seen by Dr. E. L. Brereton on April 27. Mr. R. A. Smith saw a male European Widgeon at Holland River, Bradford on April 28, 1942. It was in company with a flock of Baldpates at the time.

24. **Baldpate.** *Mareca americana.*—A fairly common spring and uncommon fall transient. The spring migration occurs between April 18 and May 26; the heaviest flights being from May 5 to May 22. Temporary field ponds occasioned by spring floods appear to be favourite resting places for the Baldpate or American Widgeon during migration. On several such ponds near Little Lake forty birds were noted by Dr. Brereton on May 5, 1939. Small numbers were recorded by Mr. D. S. Miller and the writer on April 30, 1939, at Gilford Beach, Oro Beach and Little Lake. A flock of 25 was flushed from the marsh at the mouth of Batteaux Creek, May 22, 1939. Our only summer record concerns a

single bird which was seen at the mouth of the Nottawasaga River, August 26, 1942.

Two mounted specimens taken at Little Lake about 1924 are in the Anderson collection.

Average date of spring arrival (5 years), April 25 (Barrie); earliest, April 18, 1937 (Marl Lake).

? September 22, 1921, Little Lake.*

25. **Pintail.** *Dafila acuta.*—A fairly common spring and uncommon fall transient. The peak of the spring flight occurs during the last week of April and the first week of May. On April 30, 1939, Brereton, Miller and the writer saw a flock of 150 at a temporary pond near Little Lake; by May 5, this number had increased to 250 birds. By mid-May, practically all have passed through the region.

In the fall, southbound migrants usually appear about the first week of September and are to be found in small numbers until mid-October.

Atkinson (1892) collected a specimen on October 25, 1890, at Holland River. Two mounted specimens taken at Holland River about 1900 by Mr. William Green are in the Bradford High School collection. Mr. Nicol Anderson has a specimen taken at Little Lake in 1924.

Average date of spring arrival (5 years), April 22 (Barrie); earliest, March 31, 1935 (Marl Lake).

26. **Green-winged Teal.** *Nettion carolinense.*—A fairly common spring and fall transient. This small teal often frequents quiet ponds and shallow inlets where it secures food by "tipping up" rather than by diving. Spring flights take place between April 12 and May 5. Fall migrants appear during early September and remain into the first week of November. Four individuals were seen at Oro Beach by Mr. D. S. Miller on May 2, 1938. Mr. Ted Twiss reported it common on the Nottawasaga River between Edenvale and Little Lake on September 15, 1939. Thurston and others (1892) have recorded the taking of a specimen at Holland River in August, 1890. Mr. S. Barnes has a mounted specimen taken at Collingwood about 1910.

Average date of spring arrival (5 years), April 16 (Barrie); earliest, April 12, 1930 (Little Lake); latest, November 4, 1940 (Holland River).

♀ April 12, 1930, Little Lake.* ♂ April 23, 1940, Barrie.
♀ October 4, 1939, Holland River, Bradford.

27. **Blue-winged Teal.** *Querquedula discors.*—A fairly common transient and uncommon summer resident; breeds.

The first spring transients arrive about the last week of April, and the movement continues until the middle of May. A flock of 26 was noted by Dr. Brereton at Dunsmore Slough, near Little Lake, May 14, 1939. In late August and early September, the fall flight gets underway and few birds remain by October 1. A flock of fifteen was observed at Batteaux Creek, September 6, 1937. Mr. T. Twiss reported them plentiful on the Nottawasaga River from Edenvale to Little Lake on September 15, 1939; and Dr. Brereton and the writer counted 30 on ponds near Barrie, September 24, 1939.

Ussher (1939) recorded observing three young on the lower Holland River, August 2, 1937. Pairs have been noted during the breeding season at Marl Lake, Jack's Lake, Penetanguishene and Matchedash Bay, and while strongly suspected of nesting in these localities evidence of a positive nature is, as yet, lacking.

Two mounted specimens shot at Holland River about 1900 by Mr. William Green are in the Bradford High School collection. Mr. Barnes has a specimen taken at Collingwood about 1910.

Average date of spring arrival (4 years), April 25 (Barrie); earliest, April 20, 1940 (Barrie).

28. **Shoveller.** *Spatula clypeata.*—An uncommon spring and fall transient. In the Bradford High School collection are mounted male and female specimens taken at Holland River in 1895 by Mr. W. W. Campbell, veteran duck-hunter of Bradford. In conversation with Mr. Campbell (1938), the writer heard a first-hand account of the incident relative to their capture and learned that these two birds were the only Shovellers he had ever shot in the marsh.

On May 24, 1938, a male was noted at the mouth of Batteaux Creek. Mr. C. L. Dawson informed me that three had been shot in September, 1938, at Waubaushene. Two were observed on a temporary pond near Little Lake by Dr. Brereton, May 16, 1939, and another on May 4, 1940. Mr. Vernon Hook of Barrie reported shooting a Shoveller at Willow Creek, near Minesing on September 23, 1940.

29. **Wood Duck.** *Aix sponsa.*—An uncommon transient and summer resident; breeds. This duck was formerly a common summer resident of the region which nested in hollow trees near water. Its numbers have decreased greatly during the last forty years, owing primarily to the clearing of the land and the loss of suitable nesting sites. An indication of its former prevalence is given in a letter published in *Rod and Gun* (1878) and dated at Waubaushene, August 13, 1878, as follows: "Summer ducks have not been so plentiful for years as they are now." Mr. A. D.

Henderson informed the writer that it was common in the vicinity of Little Lake between 1894 and 1898, and that young were often seen on the lake.

Two mounted specimens taken at Holland River about 1900 by Mr. William Green are in the Bradford High School collection. Mr. W. W. Campbell informed me that Wood Ducks were common and many were shot along the creeks around Bradford from 1890 to 1900. Mr. N. Anderson has a mounted specimen taken at Little Lake in 1924.

The species is now confined as a breeding bird to the larger swamps. Concerning a visit to the Minesing Swamp on May 14, 1926, Bingham (1926) states: "The Wood Duck and Hooded Merganser nest in the swamp but on this trip we secured no nests but saw several pairs of birds." Dr. Brereton and the writer saw one in the heart of the swamp on May 1, 1938. Mr. D. Butler discovered a nest of 11 eggs, in a cavity in a pine stub, at Midhurst, June 7, 1940. Harrington (1936) reported it as breeding sparingly up the Nottawasaga River, near Jack's Lake. There is some evidence to show that protection has resulted in an increase in numbers of this species in recent years. Mr. Twiss found them surprisingly common, and shot one, during a canoe trip up the Nottawasaga River, from Edenvale to Little Lake, on September 15, 1939.

♂ October 16, 1893, Holland River.*
♂ October 12, 1918, Little Lake.*
♂ August 10, 1919, Little Lake.*
♂ July 5, 1930, Little Lake.*

30. **Redhead.** *Nyroca americana.*—A rather rare transient. Atkinson (1892) reported taking one at Holland River on October 27, 1890. A mounted specimen in the Bradford High School collection was shot at Holland River by Mr. William Green about 1900. A flock of five birds was observed and a specimen collected by the writer at Wasaga Beach on October 12, 1936. Dr. Brereton reported a single individual at Kempenfelt Bay on November 4, 1939.

♂ October 12, 1936, Wasaga Beach.

31. **Ring-necked Duck.** *Nyroca collaris.*—An uncommon spring and fall transient. Appears to be more common in autumn than in spring; occasionally seen in late fall and early winter. Atkinson (1892) secured a specimen at Holland River on October 20, 1890. Two birds were seen at the mouth of the Nottawasaga River, April 22, 1934; Mr. W. W. Gunn noted two in Collingwood harbour, April 19, 1934; and Mr. D. S. Miller and the writer saw two individuals at Oro Beach, April 30, 1939. A Ring-necked Duck shot at Little Lake on November 11, 1939, by a hunter named Hutchison, was later secured by Dr. Brereton

and is now in the writer's collection. A recent winter record concerns two birds observed off Minet's Point, Kempenfelt Bay on December 26, 1940.

A Ring-necked Duck banded at Lake Scugog on October 20, 1926, was shot at Midland on October 5, 1928 (Can. Field-Nat., March, 1930, p. 72).

Earliest date of spring arrival, April 10, 1941 (Barrie).

♀ September 14, 1922, Little Lake.*	♂ November 11, 1939, Little Lake.
♀ September 24, 1930, Little Lake.*	♂ November 7, 1941, Orr Lake.*

32. **Canvas-back.** *Nyroca valisineria.*—An uncommon spring and fall transient; very rare winter visitant. According to duck hunters in the Barrie vicinity, this species is rather irregular as a fall migrant, the flight usually passing through hurriedly in late October or early November. At Little Lake, Mr. T. Twiss secured two out of a flock of six birds in November, 1938, and one from a flock of three on November 10, 1939. A male specimen taken from a flock of 15 birds on October 25, 1941, by Mr. Delbert Urry was secured by Dr. Brereton and is now in the writer's collection. Mr. Nicol Anderson has a mounted specimen which was taken at Little Lake in the autumn of 1924. Mr. C. L. Dawson informs me that a few birds are taken each fall in Matchedash Bay, and that seven were shot there in the sutumn of 1938. An interesting winter record reported by Brereton and Laws (1942) is that of an individual seen at Barrie on December 26, 1941.

♂ October 25, 1941, Little Lake.

33. **Greater Scaup.** *Nyroca marila.*—A fairly common spring and fall transient and uncommon winter visitant. This bird so closely resembles the Lesser Scaup that identification in the field is difficult and records not based on specimens collected must necessarily be open to some doubt. However, considerable care was given to sight observations in noting such points as size, colour and shape of head, and in flight, the extent of white in the speculum. It appears to be less common than the next species. Apparently it is better able to withstand colder weather conditions. Young (1905) in "*Bird notes from Penetanguishene*" states: "On December 5, 1904, I examined a female Scaup duck (*A. marila*) which was taken here. These birds winter on the Muskoka and Swim Rivers during mild winters and occasionally come into the bay here and feed at the openings at the mouths of the creeks." Mr. S. H. Henry reports this species as present at Collingwood harbour, February 14, 1913 and January 24, 1915. On December 28, 1938, 50 were noted at

Oro Beach by Messrs. Lawrie, Mowat and Helmsley; and Dr. Brereton and the writer saw two at Kempenfelt Bay, December 26, 1940.

A Greater Scaup banded at Cayuga Lake, New York, on February 23, 1923, was found unable to fly at Little Lake on May 3, 1925 (Can. Field-Nat., Oct., 1925, p. 171).

A specimen shot by Mr. Twiss at Orr Lake, November 13, 1939, was examined by Dr. Brereton and referred to this species. Atkinson (1890) records specimens taken at Holland River, October 17 to 31, 1890.

♂ May 2, 1930, Little Lake.* ♂ April 24, 1938, Wasaga Beach.

34. **Lesser Scaup.** *Nyroca affinis.*—A very common spring and fall transient and rare summer resident; breeds occasionally. This is probably the commonest duck found in the county during migration. The bulk of spring migrants pass through during the last week of April and the first week of May, flocks of 200 to 500 individuals being not uncommon during this period. Fall transients appear during the first week of October, the movement reaching its greatest proportions during the second week of that month. A large flight was witnessed by the writer at Wasaga Beach, October 13, 1940, when well over 1,000 individuals passed over within an hour.

On July 6, 1938, Dr. and Mrs. Edgar Hobbs discovered a female with five half-grown young on the Nottawasaga River, near Oakview (Baillie, 1939). Mr. C. L. Dawson informed me that this species breeds in Matchedash Bay Marsh. In support of this statement may be added the observation of two pairs at this marsh on June 15, 1939, by Mr. F. Cook and the writer.

Average date of spring arrival (4 years,) April 19 (Barrie); earliest, April 10, 1941 (Barrie).

♀ April 28, 1930, Little Lake.*

35. **Common Golden-eye.** *Glaucionetta clangula.*—A common spring and fall transient; uncommon winter visitant. At the first sign of open water, this duck puts in its appearance. It has been noted as early as February 7, on which date, Mr. Gunn saw 10 feeding among brash ice near Collingwood in 1939. A female found dead at Midhurst, February 9, 1940, by Mr. M. A. Adamson is in the R.O.M.Z. collection. Mr. S. H. Henry noted it at Collingwood on February 14, 1913. On March 27, 1938, six were observed feeding along open leads in the ice at Wasaga Beach. The heaviest flights take place in mid-April, at which time flocks of 50 to 75 have been recorded; only a few remain after May 20. Fall transients arrive in late September, reach their greatest

numbers towards the end of October and remain common well on into December. Brereton and Laws (1942) reported four at Barrie on December 26, 1941.

There are several records of occurrence in summer, but, as yet, no breeding evidence has been secured. Mr. Baillie saw three at the mouth of the Nottawasaga River, June 10, 1929; and the R.O.M.Z. survey party (Messrs. Snyder, Hope and Shortt) observed one at Penetanguishene, June 11-15, 1935. The record of a young bird taken at Orillia in 1888, by Dr. Walker, as reported by Baillie and Harrington (1936), has been found to be erroneous; this bird was later identified as a Buffle-head in eclipse plumage.

Atkinson (1892) collected one bird at Holland River, October 22, 1890. Mr. N. Anderson has a mounted specimen taken at Little Lake in 1924.

♂ May 2, 1932, Little Lake.*
♀ October 29, 1939, Crescent Harbour, Lake Simcoe.*
♂ November 13, 1939, Orr Lake.*
♀ February 9, 1940, Midhurst.*

36. **Buffle-head.** *Charitonetta albeola.*—An uncommon spring and fall transient. Spring migrants usually appear during April and have been noted as late as May 19. At Wasaga Beach, three were observed March 31, 1935; five, April 22, 1934, and Mr. D. S. Miller and the writer saw four at Gilford Beach, April 30, 1939.

Southbound transients are in evidence in late October and are present in small numbers until mid-November. Mr. W. W. Gunn reported several at Collingwood on October 24, 1939. Twelve birds were observed off Three Mile Point, Wasaga Beach, November 10, 1935.

A Buffle-head banded at Branchport, New York, on April 6, 1922, was found drowned in a herring net in Georgian Bay near Collingwood on April 17, 1922 (Lincoln, 1924).

Atkinson (1892) secured one at Holland River, October 22, 1890. A male specimen shot at Holland River by William Green about 1900, is in the Bradford High School collection. Mr. Nicol Anderson has a male taken at Little Lake about 1925.

Average date of spring arrival (5 years), April 15 (Collingwood).

♀ November 13, 1939, Orr Lake.

37. **Old-squaw.** *Clangula hyemalis.*—A rather rare spring and fall transient; occasional winter visitant. One of the few spring records was made on the night of May 17, 1931, when flocks were heard calling as they flew over Minesing by members of the Brodie Club of Toronto. Just why this species should be so rare in spring is difficult to under-

stand since it is an abundant winter resident at Toronto. Fall migrants appear during the last week of October. A single bird was seen at Wasaga Beach, October 21, 1934; Dr. Brereton noted six at Barrie, October 27, 1938; and 25 were observed at Oro Beach, December 28, 1938, by Messrs. Lawrie, Mowat and Helmsley.

A fresh specimen picked up at Wasaga Beach, October 30, 1938, showed no sign of injury. A male shot at Waubaushene, November 12, 1938, by Mr. Frank Grainger is in the R.O.M.Z. Mr. Debenham has a mounted specimen which was taken alive at Dalston about 1910. Mr. Anderson has one taken at Little Lake in 1924.

♀ October 30, 1938, Wasaga Beach. ♂ November 12, 1938, Waubaushene.*

38. **King Eider.** *Somateria spectabilis.*—An accidental visitant. A female was taken by Mr. H. B. Haugh at Little Lake on November 1, 1926 (Snyder, 1927). This is the only Simcoe record. The specimen is now in the R.O.M.Z.

♀ November 1, 1926, Little Lake.*

39. **White-winged Scoter.** *Melanitta deglandi.*—An uncommon spring and fall transient; rare winter visitant. This rather late spring migrant appears during the last half of May (May 16, 1939) and well on into June. A flock of 15 was noted flying over Kempenfelt Bay by Dr. Brereton, June 13, 1938. Mr. R. A. Smith saw a flock of 80 birds passing over Bradford on May 27, 1942. Fall transients are in evidence about the end of October and a few remain during November and December. On October 28, 1938, Dr. Brereton reported a flock of 27 at Barrie; and Mr. C. E. Molony and the writer saw five at Wasaga Beach, October 30, 1938. A single representative of the species was observed off Minet's Point, Kempenfelt Bay, December 26, 1940.

A specimen taken by Mr. H. B. Haugh (no date) at Kempenfelt Bay, Barrie, is in the R.O.M.Z. Mr. Anderson has a specimen taken at Little Lake in 1926. A female in the writer's collection was shot at Orr Lake by Mr. T. Twiss, November 13, 1939.

♀ November 13, 1939, Orr Lake.

40. **Surf Scoter.** *Melanitta perspicillata.*—A very rare fall transient. A specimen taken by H. B. Haugh at Little Lake, October 1, 1921, is in the R.O.M.Z. A mounted specimen in the collection of Mr. Anderson was shot by him at Little Lake in 1924.

? October 1, 1921, Little Lake.*

41. **American Scoter.** *Oidemia americana.*—A very rare fall transient. Atkinson (1892) reported collecting one at Holland River on October 22, 1890. A specimen taken by Mr. H. B. Haugh at Little Lake October 10, 1921, is in the R.O.M.Z. Mr. Nicol Anderson informed me that he had shot an individual of this species about 1925, at Little Lake, but the specimen had since been destroyed.

? October 10, 1921, Little Lake.*

42. **Ruddy Duck.** *Erismatura jamaicensis.*—A rare transient. This species was probably fairly common at the turn of the century but has diminished greatly in numbers and during the last decade has become decidedly rare. Atkinson (1892) speaks of shooting a number at Holland River on October 22, 1890. Dr. Harrington informed me that in 1922 a pair remained from May 19 to May 26, near a small marsh a few miles up the Nottawasaga River, but were not observed after that date.

A specimen taken by Mr. N. Anderson at Little Lake in 1924 is in his collection. On November 22, 1926, Mr. H. B. Haugh collected three specimens at Little Lake of which two were immature males; he secured a female on October 25, 1927. These specimens are now in the R.O.M.Z.

? November 22, 1926, Little Lake.* ♀ October 25, 1927, Little Lake.*
2 Imm. ♂ ♂ November 22, 1926, Little Lake.*

43. **Hooded Merganser.** *Lophodytes cucullatus.*—A fairly common spring and fall transient and summer resident; breeds. This small merganser has been noted as early as March 12 (1930), when one was taken by Mr. H. B. Haugh at Little Lake. It is fairly common in the fall, remaining well on into December.

In summer, it nests sparingly where local conditions are suitable. Dr. Harrington saw a female with ten flightless young, five miles up the Nottawasaga River on July 22, 1926. Baillie and Harrington (1936) noted a female with seven downy young at Jack's Lake, June 4, 1928. On July 1, 1939, the writer came upon a female with at least five flightless young in a marshy lagoon, two miles up the Nottawasaga River. While the young hid in the reeds the adult put on an injury feigning display. According to Bingham (1926), it nests in the Minesing swamp. On June 28, 1941, Dr. Brereton found a female with seven flightless young at the Willow Creek outlet from Little Lake.

Atkinson (1892) secured a specimen at Holland River, October 26, 1890. One taken by Dr. W. E. Saunders at Gloucester Pool, Severn River, December 1, 1900, is now in the collection of the National Museum at Ottawa. A male shot by Mr. William Green at Holland River about

1900, is in the Bradford High School collection. Mr. S. Barnes has two mounted specimens taken at Collingwood about 1910.

Average date of spring arrival (4 years), April 22 (Barrie).

2 ♂♂ April 9, 1930, Little Lake.*
♂ April 12, 1930, Little Lake.*
♀ April 12, 1930, Little Lake.*
♂ November 15, 1934, Port Severn.
♀ November 13, 1939, Orr Lake.*
♂ December 11, 1939, Midhurst.

44. **Common Merganser.** *Mergus merganser.*—A common spring and fall transient; uncommon summer resident; breeds. This species is an early spring arrival, the date of its appearance depending on weather conditions of the season. On March 27, 1938, six birds were seen in open leads in the ice at Wasaga Beach, and three others were noted in an ice-free hole at Marl Lake. The migration reaches its height in April when flocks of 50 or more individuals are often recorded. It stays late in the fall, usually well on into December, depending on the freeze-up. A few remain in the region during mild winters, individuals having been noted in January and February.

This duck breeds in more northern sections of the county, often on small uninhabited islands in Georgian Bay. Mr. H. B. Haugh found two downy young at Little Lake, June 26, 1920; and three downy young were observed at Penetanguishene by Mr. T. M. Shortt on June 11, 1935 (Baillie and Harrington, 1936). Mr. A. Beausolgard informed me that he had found a nest on Gull Island, 12th concession of Tiny township, in June, 1936. During a visit to Giant's Tomb Island, June 9-11, 1937, Mr. D. S. Scott and the writer saw female mergansers daily but were unable to secure definite breeding evidence. On June 15, 1939, a female merganser was seen to fly out from Methodist Island, near Victoria Harbour, but the nest or young were not found. On June 10, 1941, the writer encountered a female with eight flightless young near the mouth of the Nottawasaga River.

Average date of spring arrival (13 years), April 15 (Collingwood).

Juv. ? June 26, 1920, Little Lake.*
♂ October 26, 1926, Little Lake.*
♂ November 14, 1934, Port Severn.*
Juv. ♀ June 11, 1935, Penetanguishene.*
♀ February 9, 1940, Midhurst.*

45. **Red-breasted Merganser.** *Mergus serrator.*—A common spring and fall transient. The Red-breasted Merganser arrives somewhat later than the preceding species, the largest numbers appearing from the last half of April to mid-May. They seem to prefer larger bodies of water and are not common on the smaller inland lakes. On April 19, 1935, 75 were noted at Wasaga Beach; and in a flock of 50 seen off the mouth of the Nottawasaga River, May 5, 1940, a number of males were going

through courtship displays. Practically all have passed through by May 26. The fall migration takes place from the last week of September to mid-November with a few stragglers remaining on into December.

Head (1829) observed "divers" on Kempenfelt Bay in 1815, which could hardly have been other than this species. He says: "April 20th.—I saw a troop of saw-bill divers, which had taken possession of a small inlet close to the shore, where their piebald colour and pert crests looked most inviting .... On firing, they disappeared like witchcraft. Not one was hit; and they were so long under water, that I could hardly recognize the flock when they re-appeared at a great distance."

Average date of spring arrival (7 years), April 25 (Collingwood); earliest, April 10, 1941 (Barrie).

♂ October 21, 1922, Wasaga Beach.* ♂ November 14, 1934, Port Severn.
♀ November 14, 1934, Port Severn.

46. **Turkey Vulture.** *Cathartes aura.*—A casual visitant. This large carrion-eater is an occasional wanderer from the more southern counties of Ontario. On April 20, 1933, Mr. C. E. Hope observed an individual soaring over the Holland Marsh; and one was seen in the same locality on October 17, 1937, by Mr. D. Sutherland. An excellent view of one was obtained near Duntroon on August 1, 1938, as the bird soared low over the crest of the Blue Mountain. Dr. Harrington reported observing a single bird near Stayner on July 26, 1941; and Messrs. J. L. Baillie, T. Murray, Dr. R. M. Saunders and the writer saw another at Wasaga Beach on April 26, 1942. A mounted specimen in the Debenham collection, taken by Mr. William Hewitt in a mink trap at Little Lake, about 1910, was examined by the writer.

47. **American Goshawk.** *Astur atricapillus.*—An uncommon transient and winter visitant. This species is subject to periodic fluctuations in numbers, the period of abundance being reached about every ten years, at which time they appear throughout the more southern parts of Ontario in considerable numbers. The last invasion occurred during the winters of 1935-36 and 1936-37. Irregular records for this hawk are mostly confined to the fall and winter months. The southward flights usually take place during October and November; our earliest fall date is October 23, 1938, when one was caught in a trap at Midhurst by Mr. V. Miller. An immature female in the writer's collection was shot near Bradford, West Gwillimbury township on November 21, 1935, by Mr. William McDonald. At Holland River on November 6, 1938, a Goshawk in immature plumage was observed on several occasions near a patch of woods known to conceal a covey of Ruffed Grouse. An im-

mature male in the writer's collection was secured at Midhurst by Dr. Brereton on March 22, 1943. Mr. S. Barnes has an adult specimen which was shot at Collingwood about 1910. Specimens taken are referable to the Eastern Goshawk *Astur atricapillus atricapillus*.

Imm. ♀ November 21, 1935, Bradford.
♂ January 27, 1937, Churchill.
? February 15, 1937, Little Lake.*
♀ October 23, 1938, Midhurst.*
♀ January 9, 1940, Midhurst.*
Imm. ♂ March 22, 1943, Midhurst.

48. **Sharp-shinned Hawk.** *Accipiter striatus.*—A fairly common spring and fall transient and an uncommon summer resident; breeds. This little hawk usually migrates northward in April and early May. Individuals have been noted in February. On May 4, 1938, Mr. W. W. Gunn counted 12 birds flying southeast following the shoreline of Nottawasaga Bay, near Collingwood. Fall flights take place in late August and during September. Dr. P. Harrington witnessed a considerable number passing over Wasaga Beach, September 4, 1921; and eight were observed flying over Holland River, September 11, 1938. Dr. Brereton saw eight individuals in one flight at Barrie on August 23, 1941; and Mr. D. S. Miller noted four at Oro Station on September 22, 1941.

In summer, it is well distributed throughout the county but rather scarce as a breeding bird. A nest with three young was found at Little Lake by Mr. H. B. Haugh on August 3, 1919 (Baillie and Harrington, 1936); and Mr. H. P. Bingham collected a set of four eggs there on May 20, 1930, and one of three eggs on June 12, 1940. A nest containing five eggs, 20 feet up in a black spruce, was found by the writer at Tea Lake, Matchedash township on June 15, 1938. It has been noted regularly in summer in woods bordering the Holland River, and a family of four young just out of the nest was seen on July 29, 1939.

The specific name *striatus* is used since it holds priority over the term *velox* as pointed out by Snyder (1938).

Average date of spring arrival (7 years), April 27 (Barrie); earliest, February 4, 1939 (Barrie).

? September 6, 1887, Orillia.*
? August 25, 1888, Orillia.*
3 Juv. August 3, 1919, Little Lake.*
♀ August 3, 1919, Little Lake.*
Imm. ♂ August 22, 1936, Holland River, Bradford.
♂ June 15, 1938, Tea Lake.

49. **Cooper's Hawk.** *Accipiter cooperi.*—An uncommon transient and rare summer resident; breeds. This species is less common than the Sharp-shin. Usually arrives about mid-April; earliest, March 29, 1942, Big Cedar Point (Baillie). On April 19, 1939, Mr. W. W. Gunn saw four

birds migrating southeast along the shore of Nottawasaga Bay, east of Collingwood. Fall migrants in small numbers appear during September.

A nest with three eggs was found by Dr. Harrington at Jack's Lake on June 16, 1928 (Baillie and Harrington, 1936). It has been noted during the breeding season at Holland River, Otter Lake and Midhurst.

Mr. S. Barnes has a mounted specimen taken at Collingwood about 1910; and Mr. Nicol Anderson has one taken at Little Lake about 1925.

♀ June 27, 1939, Midhurst.

50. **Red-tailed Hawk.** *Buteo borealis.*—A fairly common spring and fall transient and an uncommon summer resident; breeds. The spring migration usually takes place in April. Five birds were seen circling slowly in a generally northeasterly direction over Wasaga Beach on April 30, 1932. Fall flights occur in September and October. Twenty-five individuals on October 12, 1942, at Wasaga Beach is the largest number recorded on a single day.

This species is a regular but rather scarce summer resident of local distribution. Mr. H. P. Bingham found a nest with two eggs on the east side of Little Lake in the spring of 1905. In the same locality, on April 24, 1938, a pair was watched as they wheeled and screamed over what appeared to be a partially finished nest, about 80 feet up in a large maple. Subsequent visits failed to establish the fact that the birds remained to breed. However, on May 12, 1940, Mr. H. P. Bingham collected a set of two eggs from a nest, 50 feet up in a large basswood, on the east shore of the lake. A nest with young was found by the writer, some 80 feet up in a beech, at Edward's Lake on July 6, 1941. Widely scattered records of summer occurrence include: one seen at Orr Lake, June 7, 1929, by Mr. J. L. Baillie; one observed near Penetanguishene, June 11-15, 1935, by the R.O.M.Z. survey party; one on Giant's Tomb Island, June 11, 1937; a pair observed at the south end of Tea Lake, June 16, 1938, by Mr. R. D. Ussher and the writer; and an individual observed near Lisle, Tossoronto township by Mr. J. C. Hall on August 7, 1939.

The stomach of an immature examined at R.O.M.Z. and taken at Little Lake, September 28, 1925, by Mr. H. B. Haugh, contained the remains of a toad (*Bufo americanus*) (Snyder, 1932). A mounted specimen taken at Little Lake about 1925, is in Mr. Nicol Anderson's collection.

Average date of spring arrival (5 years), April 1 (Barrie); earliest, March 29, 1940 (Barrie).

? October 22, 1932, Bradford.* ♂ September 21, 1933, DeGrassi Point, Lake Simcoe.*

51. **Red-shouldered Hawk.** *Buteo lineatus.*—An uncommon transient and rather rare summer resident; breeds. The status of this species in the county is similar to that of the Red-tail, but it apparently requires less extensive plots of woodland for nesting purposes. Spring migrants appear during the first half of April (earliest, March 29, 1942, Big Cedar Point).

On May 15, 1940, an adult was flushed from a nest, 40 feet up in a beech, at Little Lake, by Dr. Brereton. The nest was later examined by the writer on June 13, 1940, but instead of the expected young, only broken egg shells were found, apparently the work of some predator. Mr. D. Butler reported finding a nest with eggs at Little Lake in 1938. Dr. Harrington (MS) lists the species as "rare" in the Wasaga Beach vicinity but states that "birds were seen on many occasions in June and July, 1924, about 5 miles up the Nottawasaga River." Other summer occurrences include individuals seen at Port Severn on June 16, 1935; at Minesing, June 13, 1939; near Lisle by Mr. J. C. Hall on August 5, 1939; at Big Cedar Point, June 19, 1941; and Lefroy, June 20, 1941. Six individuals of this species were seen migrating over the Holland River on September 13, 1942.

52. **Broad-winged Hawk.** *Buteo platypterus.*—A fairly common spring and fall transient; uncommon summer resident; breeds. Early migrants appear in April, and the movement continues well on into May. Dr. P. Harrington witnessed a large flight of Broad-wings over Wasaga Beach on May 6, 1922; while the writer counted over 20 passing the same area on April 26, 1942.

It is rather scarce as a breeding bird, being somewhat commoner in northern sections of the county. At Little Lake, Mr. H. P. Bingham took a set of three eggs on May 22, 1933, and one of three eggs on May 16, 1940. At Lefroy, the writer discovered a nest containing three eggs, 20 feet up in a beech on June 20, 1941. Weekly visits were made to this nest from July 1, when the young hatched, until August 2, at which time the young appeared fully grown and about ready to fly, having been 33 days in the nest. A set of two eggs in the writer's collection was taken from a nest 35 feet up in a white cedar, 4½ miles southwest of Bradford, on June 13, 1943. Individuals have been seen during the breeding season at Black Lake on June 18, 1935, by Mr. R. A. Smith; at Port Severn, July 25, 1935, by Mr. D. S. Scott; and Mr. R. D. Ussher and the writer observed one at Severn Falls on June 13, 1938, and two at Tea Lake on June 15, 1938.

The fall migration reaches its greatest proportions during the first two weeks of September. Dr. P. Harrington (MS) described it as "abundant" at Wasaga Beach on September 4, 1921. Ten birds were observed passing over Holland River on September 13, 1942. Two individuals reported by Mr. D. S. Miller at Oro Station on September 23, 1941, constitute our latest autumn record.

Average date of spring arrival (6 years), April 28 (Collingwood); earliest, April 22, 1917 (Collingwood).

? August 25, 1887, Orillia.*
? September 15, 1888, Orillia.*
♀ August 25, 1932, Craighurst.*

53. **Common Rough-legged Hawk.** *Buteo lagopus.*—An uncommon spring and fall transient. This large buteo is one of the first hawks to arrive in spring and among the last migrants to pass through in the fall. Northbound transients arrive early in April. The southward movement extends from October 12 (1940) to November 21 (1937). On October 17, 1937, one was observed hovering over a small marshy area at Two Mile Point, Wasaga Beach. It suddenly plunged into the marsh grass and came up with a frog clutched in one talon and flew off. Five birds were noted at Minesing, November 11, 1938, by Messrs. D. S. Miller and F. Banfield. Small numbers are seen regularly each October and November moving southwest up the Holland River. Four individuals were seen in this locality on November 14, 1941, by Mr. R. A. Smith.

Two mounted specimens taken at Dalston about 1910 are in the Debenham collection. Mr. Nicol Anderson has two specimens shot at Little Lake about 1925.

Average date of spring arrival (3 years), April 7 (Barrie).

♀ October 21, 1938, Midhurst.
♀ November 11, 1941, Hawkestone.*

54. **Golden Eagle.** *Aquila chrysaetos.*—A very rare visitant.

In the Toronto *Globe* for November 10, 1927, a report from Orillia states: "Andrew Ingles of the second concession, North Orillia, brought into town a very fine golden eagle which he had shot on his farm. With wings extended the bird measured seven feet from tip to tip. Eagles are very rarely seen in Orillia Township."

In November, 1932, an adult was shot by Mr. William McDonald at the Holland River in the third concession, West Gwillimbury township. The bird was given to Mr. Albert Ford, a local farmer, who had it mounted. This fine specimen was examined by the writer in 1937.

55. **Bald Eagle.** *Haliaeetus leucocephalus.*—A rather rare transient and occasional winter visitant.

Sagard's reference to "eagles" in 1623 may have been this species, but was more likely to have been the Osprey. An observation of this or the preceding species is found in the diary of Alexander Macdonell under date of October 16, 1793: "When we came to the forks of the river (Holland) we saw an eagle sitting on a muskrat house. The Indian in the bow fired, but in vain, being only loaded with duck shot." (Macdonell, 1890). Head (1829) reported "a white-headed eagle soaring high in the air" over Kempenfelt Bay on May 7 or 8, 1815. Records for this species reveal that it has been observed in ten of the twelve months of the year, but not more than three or four birds each year. Two adults were seen at Collingwood, January 31, 1939, by Dr. R. M. Saunders; and from March 8 to March 12, 1939, an adult was seen to feed daily on the carcass of a cow at the farm of Mr. William Ward, near Edenvale, Flos township. The only summer occurrence we have is that of an individual seen June 12 and July 16, 1919, at Wasaga Beach by Dr. Harrington.

A specimen taken at Waubaushene, November 12, 1890, has been recorded by W. Melville of Orillia (1892). An immature which was caught in a trap at Allenwood Beach, Nottawasaga Bay about 1900, by Mr. Edward Grigg, is now in the possession of his grandson, Mr. Clifford Grigg of Allenwood, where it was recently examined by the writer.

56. **Marsh Hawk.** *Circus hudsonius.*—A common transient and summer resident; breeds. This is our commonest and most evenly distributed hawk and the one most often observed owing to its habit of flying low over marsh and farmlands in search of mice. A blue male was seen as early as February 20 (1938), flying over the frozen marsh at Holland River; and individuals have been observed as late as the first week of November.

It breeds fairly commonly in suitable marshes and wet meadows. Baillie and Harrington (1936) have recorded it nesting at Minesing and DeGrassi Point; other known breeding areas include Big Cedar Point, Little Lake, Beeton and Marl Lake. It nests regularly at the Holland River Marsh where pairs have been observed carrying nesting material on May 8, and completed sets of eggs found on May 22; young breaking through the shell have been watched on June 15, and young on the wing have been seen on July 9. A nest located at Marl Lake had three eggs on June 5, 1939, and recently hatched young on July 1. A set of five eggs, taken by Mr. H. B. Haugh on June 18, 1916, at Little Lake is in the R.O.M.Z.

Average date of spring arrival (8 years), April 8 (Bradford).

Imm. ♂ September 12, 1937, Cook's Bay.

57. **Osprey.** *Pandion haliaetus.*—An uncommon spring and fall transient and summer resident. An individual was observed flying over the Holland River on April 28, 1929, by Messrs. J. L. Baillie and T. F. McIlwraith; and Ussher (1939) has reported the occurrence of three over the lower Holland Marsh on August 2, 1937.

This species, often referred to as the Fish Hawk, formerly bred at Three Mile Point, Wasaga Beach, where Dr. Harrington located a nest in 1913. The tree which held the nest was destroyed and the birds left. However, an occasional bird is still to be seen in this locality; an individual was observed at Marl Lake, July 15, 1934, and Dr. Harrington saw two there in the summer of 1937. Mr. A. D. Henderson informed the writer that in 1895, he saw three nests at Little Lake, two at the outlet and one at the inlet, built at the tops of tall pine stubs which towered above the surrounding forest. One nest blew down during the fall of 1895, and another was cut down the following winter. On April 16, 1897, he saw an Osprey perched on the remaining nest at the outlet whilst another bird soared overhead. Mr. H. P. Bingham reported seeing Ospreys carrying fish from Little Lake to a large nest in a conifer on the east side of the lake about 1924. The following year, the tree was cut down and the hawks departed. This species is believed to nest sparingly along the Severn River, although no actual nests have been observed. Summer occurrences in this area would tend to strengthen this probability. An individual was observed on June 16 and 17, 1935, at Otter Lake; another on June 14, 1938, at Severn Falls; one at Grass Lake, June 21, 1939; and a single bird at Port Severn on July 25, 1935, by Mr. D. S. Scott.

On September 7, 1941, during a flight of hawks at Holland River, two Ospreys were observed passing over in a southerly direction.

♀ September 15, 1934, Bradford.

58. **Peregrine Falcon.** *Falco peregrinus.*—A rare transient and summer visitant. Although this species nested at Redwing, in Grey County (nine miles west of Collingwood) as late as 1934 (Baillie and Harrington, 1936), its presence in the county has been detected on but few occasions.

On October 7, 1934, at Three Mile Point, Wasaga Beach, one was seen to stoop at a flock of five Black Ducks, forcing one of them to plunge headlong into the bay in order to escape. Another or possibly the same hawk was noted there on October 20, 1934. Individuals were observed at Wasaga Beach, August 22, 1937, and at Holland River, September 12, 1937. A single bird, which passed over within 50 yards of the observer, was noted by Dr. Brereton at Little Lake on September 13, 1941.

59. **Pigeon Hawk.** *Falco columbarius.*—An uncommon spring and fall transient. The spring migration is not well defined but migrants usually are in evidence during April and early May (earliest, March 23, 1940, Barrie). Messrs. G. H. Richardson, S. C. Downing and the writer saw one at Holland River on April 25, 1935; and a single individual was seen at Ferndale, near Barrie, on May 11, 1941. In the fall, southbound transients in small numbers have been noted from September 3 (1934) to September 24 (1939).

While observing birds at Marl Lake on September 23, 1934, the writer had a Pigeon Hawk swoop by within a few yards of his head, in an attempt to capture a Black-capped Chickadee. The stomach of a specimen examined at R.M.O.Z. and taken by Mr. H. B. Haugh, September 19, 1925, at Little Lake was found to contain remains of a dragonfly (Odonata) (Snyder, 1932). A specimen shot at Holland River in August, 1890, has been reported by Thurston, Deacon and Atkinson (1892).

? September 19, 1925, Little Lake.*

60. **American Sparrow Hawk.** *Falco sparverius.*—A fairly common transient and summer resident; rare in winter; breeds. This brightly plumaged little falcon prefers the more open borders of woods near clearings for its hunting.

Sets of eggs found at Barrie in 1915, and at Midhurst in 1920, by Mr. H. P. Bingham have been recorded by Baillie and Harrington (1936). An occupied nesting cavity 15 feet above the ground in a pine stub was found by Mr. J. C. Hall on May 28, 1939, near Lisle, Tossoronto township. A female, accompanied by two flying young which repeatedly begged for food, was seen at Alliston on July 15, 1939. A pair was observed and the female seen to enter a hole, 35 feet up in a dead stub, bordering Willow Creek in Oro township on May 26, 1940.

Winter occurrences include one observed near Wasaga Beach in Nottawasaga township on January 8, 1933; and an individual was seen to kill two English Sparrows near farm buildings at Holland River on January 30, 1939, by Mr. D. Sutherland.

Average date of spring arrival (5 years), April 15 (Collingwood).

♂ about 1890, East Oro.* ♂ September 12, 1937, Holland River, Bradford.

61. **Spruce Grouse.** *Canachites canadensis.*—A former resident, now believed extirpated. This species has been unable to withstand the advances of civilization and the last fifty years have witnessed its gradual disappearance. There remains the remote possibility that a few pairs may yet persist in some isolated swamp in northern sections of the county.

That the Spruce Grouse was formerly fairly common may be gathered from the literature. Head (1829) recorded it at Kempenfelt Bay in 1815, and commented on the strong flavour of its flesh. King (1866) reported finding it near Penetanguishene. Melville (1892) recorded having shot a specimen at Orillia on December 15, 1890. A mounted specimen in the collection of Mr. S. Barnes was taken by him at Collingwood about 1910.

In reply to an inquiry by the writer, Mr. A. D. Henderson of Belvedere, Alberta, former resident of Barrie writes: "About 1888 for three or four years R. Dunlop shot Spruce Grouse, several each year, in the swamp between Barrie and Colwell on the south side of the railway track between it and the Essa hills."

62. **Ruffed Grouse.** *Bonasa umbellus.*—A permanent resident species. The Ruffed Grouse or "partridge" is subject to periodic fluctuations in numbers and in Ontario this phenomenon was made the subject of a study by Clarke (1936) who concluded that "the average periodicity is certainly very close to ten years, possibly a little less." Records of grouse numbers kept by Dr. Harrington and the writer for the South Georgian Bay region since 1919, and latterly for the county as a whole conform closely to a ten year cycle. Grouse were abundant in the years 1923, 1932 and 1940-41. A definite scarcity was noted in 1927 and 1936.

Champlain (Bigger, 1929) and Sagard (Wrong and Langton, 1939) recorded "partridges" as occurring in the area in the 17th century. Head (1829) mentioned shooting five "birch partridges" on March 20, 1815, at Kempenfelt Bay. A reference in *Forest and Stream* (1874) told of fourteen being shot by a party of hunters at Bradford. Nicol (1892) reported it plentiful at Cookstown, and Atkinson (1892) noted it at Holland River.

This species occurs and nests throughout the county except in extensively cultivated areas. Early nesting dates include a set of ten eggs found by Mr. D. Sutherland, May 12, 1939, at Holland River, and a set of twelve eggs found by Mr. W. W. Smith, May 12, 1940, at Big Cedar Point. In a nest of fourteen eggs located by Mr. J. J. Baker at Big Cedar Point, the young were breaking through the shell on June 2, 1940; and Dr. Harrington secured a downy young, a few days old, on June 2, 1929, at Wasaga Beach. Young able to fly short distances were noted at Severn Falls on June 13, 1938, and in the same locality, a bird was flushed from a set of eleven eggs on June 17, 1938. In the south Georgian Bay region Starr (1923) recorded "as many as 7 hens with broods seen in one day." A set of nine eggs, taken by J. Edmonds on May 22, 1932, Wasaga Beach, is in the R.O.M.Z.

According to Fleming (1907) the subspecies occurring in this section of Ontario is the Canada Ruffed Grouse *Bonasa umbellus togata.*

? fall, 1889, Lefroy.*
♂ December 10, 1925, Barrie.*
♂ December 11, 1925, Little Lake.*
♀ December 12, 1925, Little Lake.*
♂ December 13, 1925, Little Lake.*
♀ December 17, 1925, Barrie.*
Juv. ♀ June 2, 1929, Wasaga Beach.*
♀ May 24, 1933, DeGrassi Point.*
♂ October 16, 1933, Orillia.*

63. **Gray** or **European Partridge.** *Perdix perdix.*—The European Partridge (also known as Hungarian Partridge) was first introduced in the county in 1939. In the spring of that year, Game Overseer Gordon D. Buie of the Ontario Department of Game and Fisheries released ten birds in the vicinity of Stayner. The success of this introduction seems assured. A recent letter from Mr. Buie states that "last fall (1941) there were a dozen different flocks of Hungarian Partridge in the vicinity of Stayner and in Sunnidale township. A couple of flocks were also noted to have strayed over into adjoining Nottawasaga township."

64. **Bob-white.** *Colinus virginianus.*—During an early historic period this species was a common resident in southern sections of the county; now believed extirpated. There is no evidence that the Bob-white was present in the county before it was opened up by pioneers. It seems probable that when the land was partly cleared conditions were better suited to the requirements of the quail, and they came in. Later, overshooting and intense cultivation which destroyed suitable cover led to their extermination.

The earliest reference we have to this species is that given by The Reverend Thomas Williams (1908), who, as a twelve year old child, settled with his parents on the Penetanguishene road, near Craighurst, in 1822. In his reminiscences of this early period, he stated: "We had also as a frequenter of our fields, the American Quail. He was seldom killed. We so much admired his pretty ways and cheerful call of "Bob-white", we did not think of shooting him. My father once shot our cat because she caught the quails which came into our barnyard. In the early years of the settlement they were quite numerous in summer. We thought they went south in winter and returned to their summer haunts in spring. When the country began to fill up with settlers, they ceased coming."

A letter written by Mr. John B. Spurr of Bradford to Mr. Ernest Thompson-Seton about 1885 contained the following note: "Quail—very rare, seldom met with; it used to be very common." A copy of this letter was sent to the late Mr. J. H. Fleming about 1906. The writer has been told that this species occurred on his grandfather's farm in the ninth concession of Sunnidale township in 1890. Dr. Harrington states that Mr. Bert Woods, mill-owner at Shrigley's Creek, three miles east of Wasaga Beach informed him that a pair of Bob-whites had been present in that vicinity for several years, about 1910.

65. **Common Pheasant.** *Phasianus colchicus.*—An uncommon resident except along the southern border of the county, where it is fairly common. In 1922, the Provincial Department of Game and Fisheries began propagating pheasant eggs at Eugenia, in adjacent Grey County. In that year, some 3,000 eggs were furnished to sportsmen and farmers in various parts of Ontario (Dept. Game and Fisheries 16th Annual Report, 1922). It seems likely that Simcoe birds originated from this source. Pheasants were first observed in the Nottawasaga Bay region in 1925, by Dr. Harrington (MS). A male was seen by him at Collingwood on June 11, 1929.

Up to the present time, however, the Pheasant has been unable to establish itself in the county with the same degree of success attained in the more southern sections of the province. The reason for this is probably the fact that the Pheasant, being primarily a ground feeder, has difficulty in finding an adequate winter food supply in a region where heavy snowfalls cover the ground for months at a time. An attempt was made to introduce this species into the Orillia area in 1929. The birds appeared to do well for several years but severe winters and illegal hunting so reduced their numbers that few, if any, remain. Individuals are occasionally seen near Barrie, and three were seen at Hawkestone by Mr. D. S. Miller on June 7, 1936. Specimens secured at Little Lake in 1931, by Mr. H. B. Haugh, are in R.O.M.Z.

Pheasants are frequently seen and heard in the vicinity of the Holland River Marsh where a covey of eight flying young was encountered on August 14, 1937; and Messrs. R. D. Ussher and W. V. Crich saw a female and eight young on June 9, 1938. Mr. R. A. Smith found a nest containing 14 eggs at Bradford on May 16, 1939.

♀ February 1, 1931, Little Lake.* ♂ November 15, 1931, Little Lake.*

66. **Wild Turkey.** *Meleagris gallopavo.*—A former resident; extinct for many years. Referring to the occurrence of the Wild Turkey in 1623, Sagard (Wrong and Langton, 1939) wrote: "In some districts, and especially near the 'Tobacco tribe' [inhabited sections of Nottawasaga township] there are Turkeys, which they call 'Ondettontague', not tame, but migrating wild birds. The son-in-law of the great chief of our town

chased one for a long time near our hut but was unable to catch it. For though these turkeys are heavy and clumsy they can fly, and in spite of their weight make their escape from tree to tree, and in this way avoid the arrows. If the savages were willing to give themselves the trouble of feeding young ones they would domesticate them as well as we do . . ." The Wild Turkey is mentioned in Le Jeune's *Relation* of 1637 (13:241), wherein a Huron ceremonial feast at Ossossane is described in which the medicine man carried a turkey's wing with which he gravely fanned the guests. Recent archaeological evidence of the presence of the Wild Turkey in Simcoe County (Wintemberg, 1935) substantiates these early statements. In 1926, W. J. Wintemberg discovered turkey bones in refuse deposits of a Tionontati indian village site near Creemore, Nottawasaga township. More recently, Mr. T. G. Connon found a humerus bone of a turkey in a refuse pit at a post-European Huron village site in Tay township.

The Wild Turkey was a bird of the mature forest and while evidence of its occurrence during the early years of settlement is lacking, it doubtless still existed in small numbers in some of the larger timbered areas. With the cutting down and elimination of its natural habitat it was doomed to extirpation.

Hypothetical

Sandhill Crane. *Grus canadensis.*—A former transient, now extirpated. The inclusion of this species is based on Sagard's account (Wrong and Langton, 1939) in 1623. At that time he wrote: "In the season all the fields are covered with cranes or "Tochingo", which come to eat the corn at seed-time and when it is ready to harvest. The wild geese and crows do the same. They (Hurons) kill some of the cranes and geese with their arrows, but rarely get them, because unless these great birds have their wings broken or are mortally wounded they easily carry off the arrow in the wound."

Until more evidence of a conclusive nature is forthcoming this species is considered as hypothetical.

67. **Virginia Rail.** *Rallus limicola.* A fairly common transient and summer resident; breeds. This well-distributed species arrives in our marshes early in May. It remains well on into the fall, two having been seen in the marsh at Collingwood on October 9, 1939; and Atkinson (1892) mentioned seeing one at Holland River on October 26, 1890.

Records of its breeding at Barrie and Minesing have been published by Baillie and Harrington (1936); at the latter place they found it to be surprisingly common and many nests, containing from five to eight eggs, were located on June 7, 1927. On May 20, 1940, Dr. Brereton observed a nest with 11 eggs at Dunsmore's Slough near Little Lake, and the writer has seen young there as early as June 13 (1940). A nest with eight eggs was found by Dr. Harrington at Marl Lake, June 5, 1927. This species has been found breeding at Big Cedar Point by Mr. W. W. Smith (set of four eggs, June 18, 1940).

Average date of spring arrival (4 years), May 8 (Barrie); earliest, May 1, 1941 (Barrie).

? May 17, 1925, Little Lake.* ♀ May 17, 1939, Barrie.

68. **Sora Rail.** *Porzana carolina.*—A fairly common transient and summer resident; breeds. The status of this species in the county is similar to that of the Virginia Rail. Arrives early in May, but appears to depart somewhat earlier in fall than the preceding species (latest, September 5, 1938).

It breeds regularly in marshy situations. Mr. F. S. Cook and the writer found it to be fairly common in the marshes at Waubaushene and Fesserton on June 16, 1939. Its nesting in 1929, at Minesing and Marl Lake, has been recorded by Baillie and Harrington (1936). A nest containing six eggs and two recently hatched young was found by Dr. Harrington at Marl Lake, June 5, 1927. Mr. H. P. Bingham took a set of 13 eggs at Little Lake on June 1, 1930. On July 29, 1937, five Sora Rails in immature plumage were flushed from the Holland River Marsh at Bradford. A single egg of this species was found deposited in an old nest of the Red-winged Blackbird at Mud Lake, near Anten Mills on June 13, 1939. Mr. Justin McBride showed the writer a set of nine eggs at Minesing swamp on May 11, 1941.

Average date of spring arrival (4 years), May 6 (Barrie), earliest, May 1, 1941 (Barrie).

♂ June 13, 1940, Little Lake.

69. **Yellow Rail.** *Coturnicops noveboracensis.*—A very rare and locally distributed summer resident; breeds. This is undoubtedly the rarest and most secretive of all our rails. Slow to flush, it is seldom seen but may be identified by its rhythmic "clicking", heard especially in the evening. A letter on file at the R.O.M.Z. from Mr. C. W. Nash written to Dr. W. E. Saunders of London, Ontario, states that the writer collected a male Yellow Rail at Holland Marsh on September 19, 1908. This appears to be the earliest record for the county.

A single bird was flushed from the marsh at Cranberry Lake, Tiny township, by Dr. Harrington and Dr. Starr on June 12, 1929; subsequent visits, however, failed to produce further records. On May 25, 1929, Messrs. J. L. Baillie, R. J. Rutter and R. Bennett noted an individual of this species at the Holland River Marsh, in York County. Its presence on the Simcoe County side of this marsh was detected on July 7, 1937, when Messrs. R. D. Ussher and D. A. Ross heard at least three "clicking" near Bradford. The finding of this rail nesting in the Holland River Marsh by the writer on June 12, 1938, has been dealt with in a fuller account in the *Auk* (Devitt, 1939). The nest and seven eggs have been deposited in the R.O.M.Z. In 1941, Mr. John MacArthur reported at least six "clicking" in the marsh near Bradford on May 27, and several were recorded by the writer on June 20, and again on July 9.

♂ July 17, 1937, Bradford. ♂ June 3, 1938, Bradford.*

70. **Common Gallinule.** *Gallinula chloropus.*—A fairly common summer resident, its distribution being limited to suitable cat-tail marshes, where it breeds.

Thurston and others (1892) mentioned that "Gallinules (*Gallinula galeata*) were common at the mouth of the [Holland] river." Atkinson (1892) secured a specimen there on October 23, 1890.

The Common Gallinule arrives from the south about the first week of May and is present until October (latest, October 23, 1890). Baillie and Harrington (1936) have recorded this species nesting at Little Lake in 1918, and at Marl Lake in 1928. Complete sets of eggs have been found as early as June 2 (1940), by H. B. Bingham at Little Lake. Dr. Harrington found a set of 11 eggs at Orr Lake on June 7, 1929. At Mud Lake, near Anten Mills, an adult accompanied by one young was seen on August 20, 1938. It was found to be unusually common in the marshes of the Matchedash Bay area on June 16, 1939, when two nests, containing eight and nine eggs, respectively, were located near Waubaushene, and two nests with ten eggs and one nest with nine eggs were found near Fesserton.

A specimen taken at Collingwood about 1920 is in the Barnes collection.

Average date of spring arrival (5 years), May 4 (Barrie); earliest, May 1, 1941 (Barrie).

♂ July 5, 1930, Little Lake.*

71. **American Coot.** *Fulica americana.*—An uncommon summer resident; breeds. Spring migrants appear in this region towards the latter part of April and the species is present in suitable marshes until well into October (latest, October 23, 1890). The Coot occupies much the same type of habitat as the Common Gallinule and the two may be

found nesting in close proximity, but the present species appears to be a much less common bird. Thurston and others (1892) reported that "Coots (*Fulica americana*) were common at the mouth of the [Holland] river . . . we secured several . . . and J. R. Thurston secured a Coot's nest containing four eggs." The status of this species as a breeding bird in the Holland River Marsh seems to have changed since 1890, and there are no recent records of summer occurrence. A set of seven eggs taken on June 16, 1918, by H. P. Bingham at Little Lake has been recorded by Baillie and Harrington (1936); other nests were found there by the same observer in 1931 (set of eight, May 28; set of nine, June 4). The writer found it breeding at Matchedash Bay on June 16, 1939, when nests containing one and eight eggs, respectively, were observed. An individual seen at Jack's Lake on June 4, 1928, by Messrs. Baillie and Harrington was probably breeding there.

Atkinson (1892) shot two specimens at Holland River, October 22, 1890. A specimen secured at Little Lake by Dr. Brereton on May 19, 1939, is in the writer's collection.

Average date of spring arrival (4 years), April 28 (Barrie); earliest, April 19, 1941 (Barrie).

♀ May 19, 1939, Little Lake.

72. **Piping Plover.** *Charadrius melodus.*—An uncommon summer resident, locally distributed where suitable sand beaches are found; breeds. This musical little plover appears along our beaches about the middle of May. Towards the end of July a tendency to congregate in flocks has been noticed; ten birds were observed on July 21, 1935, at Two Mile Point, Wasaga Beach. The fall migration continues into September (latest, September 16, 1939).

This species was formerly a fairly common breeding bird along Wasaga Beach, but the building of summer cottages in recent years has reduced this population to a few pairs. Complete sets of eggs have been found as early as May 14 (1933), and young observed on June 4. Baillie and Harrington (1936) have recorded finding newly hatched young at Wasaga Beach on June 20, 1913, and also a set of four eggs found by the writer on May 20, 1934. A bird was observed incubating a single egg near the mouth of the Nottawasaga River on July 1, 1938. The nesting depression was situated on a section of the beach used by automobiles and was, in fact, between tire tracks. The lateness of the date would seem to indicate a second attempt at nesting after the first set had been destroyed. The presence of three individuals on the eastern sand beach of Giant's Tomb Island on June 11, 1937, denotes another probable breeding location.

Average date of spring arrival (9 years), May 16 (Wasaga Beach); earliest, April 27, 1941 (Wasaga Beach).

♀ July 21, 1935, Wasaga Beach.

73. **Semipalmated Plover.** *Charadrius semipalmatus.*—A fairly common spring and fall transient. Spring migrants arrive about the middle of May, and from one to twenty-five individuals may be seen daily until well into June (latest, June 9, 1940). The post-breeding migration is underway in late July; three birds were seen at Wasaga Beach, July 26, 1942. The movement continues during September and October (latest, October 17, 1937).

This species occasionally visits temporary ponds in fields. Two were seen by Mr. W. W. Gunn at a small pond near Elmvale on September 27, 1938, and Dr. Brereton saw one under similar conditions at Barrie on May 20, 1940.

Average date of spring arrival (7 years), May 25 (Wasaga Beach); earliest, May 19, 1935 (Wasaga Beach).

♂ May 19, 1935, Wasaga Beach. ♀ August 18, 1935, Wasaga Beach.

74. **Killdeer.** *Oxyechus vociferus.*—A common transient and summer resident; breeds. This familiar plover is among the first birds to return in the spring, arriving towards the latter part of March and announcing its presence with vociferous cries of "Kill-dee." By no means confined to the shore or mud flat, it is equally at home in cultivated fields or along roadside ditches.

The Killdeer is a common breeding bird throughout the county. Nests with the full complement of four eggs have been found at Holland River as early as April 17 (1939), by Mr. R. A. Smith. A set of four eggs taken by Dr. Harrington on July 2, 1923, at Collingwood and a set of four eggs collected by H. P. Bingham on May 8, 1923, in Vespra township have been recorded by Baillie and Harrington (1936). Two occupied nests, within a radius of 100 yards, were located at Two Mile Point, Wasaga Beach, on June 22, 1934. It was found nesting on Giant's Tomb Island on June 11, 1937. For several years in succession a pair nested within a few feet of the railway tracks near Bradford, seemingly unperturbed by the rushing locomotives. Young have been seen as early as May 18 (1941), by Mr. W. W. Smith at Big Cedar Point.

In July, they begin to congregate in flocks in preparation for the southward flight (25 at Wasaga Beach, July 14, 1935). During August and September concentrations of 50 to 150 birds have been noted; the numbers involved in the autumn movement decrease gradually into October (latest, October 21, 1934).

Average date of spring arrival (16 years), March 30 (Collingwood); earliest, March 11, 1921 (Collingwood).

? August 20, 1889, Orillia.*
♂ May 21, 1932, Wasaga Beach.*
♂ April 8, 1937, Bradford.

75. **Golden Plover.** *Pluvialis dominica.*—A rare fall transient; no spring records. With the exception of a specimen shot in November, 1925, at Wasaga Beach by Dr. Harrington, all other records for this species fall between the dates of September 3 (1933) and October 4 (1941). The average autumn arrival date at Wasaga Beach for 7 years is September 19. Three individuals seen there on September 3, 1933, was the greatest number to be observed in a single day. On September 27, 1938, two were observed in a flooded field at Elmvale by Mr. W. W. Gunn. Dr. Brereton saw two at Wasaga Beach on September 15, 1940. A specimen taken at Little Lake by Mr. A. Debenham about 1890 is in his collection.

? November, 1925, Wasaga Beach.*
♀ September 25, 1938, Wasaga Beach.

76. **Black-bellied Plover.** *Squatarola squatarola.*—An uncommon spring and common fall transient. This plover appears during the latter half of May, often frequenting ploughed fields as well as beaches. As a general rule the spring flight is light; the greatest number observed was twenty-one on May 24, 1935, at Wasaga Beach. A few linger on into June (latest, June 4, 1939).

During the autumn migration the species is much more common. Southbound migrants have been seen at Wasaga Beach on August 1 (1936), and from then on flocks of from ten to twenty-five individuals are noted daily. The flight reaches its height in late September. Over 100 birds were observed at Wasaga Beach on September 22, 1935. It continues to be fairly common during October and a few stragglers have been noted in November (latest, November 11, 1934).

Average date of spring arrival (7 years), May 25 (Wasaga Beach); earliest, May 16, 1940 (Barrie).

♀ October, 1924, Wasaga Beach.*
? September 8, 1925, Little Lake.*
? September 24, 1930, Little Lake.*
♀ May 24, 1935, Wasaga Beach.
♀ September 22, 1935, Wasaga Beach.
♂ October 18, 1941, Wasaga Beach.*

77. **Common Turnstone.** *Arenaria interpres.*—An uncommon spring and rather rare fall transient. In spring, this strikingly coloured shore-

bird arrives in late May, and until the first week of June, is to be observed in flocks of from two to ten individuals (latest, June 7, 1928). A flock of twelve was noted at Wasaga Beach on June 6, 1927, by Dr. Harrington.

Fall migrants have been observed in small numbers at Wasaga Beach from September 2 (1934) to October 13 (1940).

A specimen taken at Collingwood about 1910, is in the Barnes collection.

Average date of spring arrival (7 years), May 26 (Wasaga Beach); earliest, May 20, 1940 (Wasaga Beach).

♀ May 24, 1938, Wasaga Beach.

78. **American Woodcock.** *Philohela minor.*—An uncommon spring and fall transient and summer resident; breeds. The American Woodcock arrives in April. Messrs. D. S. Miller and G. Beare reported observing twenty-five at Minesing on April 18, 1938, and several were heard performing courtship flight songs on the evening of April 19. This spectacular flight display has been observed as late as May 16 (1931), in the same locality by Mr. J. L. Baillie.

Nicol (1888) gives the impression that it was quite common in the region in the 80's, during the fall hunting season. In the vicinity of Cookstown, he wrote that "they do not appear in numbers until late September or early October." In 1887, he stated that seventeen were shot on October 12; twelve on October 13; and eight on October 15. Fall flights still take place but the large numbers reported in earlier days no longer occur.

At Wasaga Beach, a brood of three young, about a week old, was found by Dr. Harrington on May 20, 1922 (Baillie and Harrington, 1936); and the writer encountered an adult and two young near Oakview on June 13, 1941. Mr. H. P. Bingham collected a set of four eggs on April 16, 1937, in the 8th concession of Vespra township, near Barrie. At Big Cedar Point, two young were seen on May 21, 1933, by Mr. J. J. Baker, and four young on May 25, 1941 by Mr. W. W. Smith. Two young birds, just able to fly, accompanied by an adult, were flushed from wet woods near Essa station on May 26, 1940.

Average date of spring arrival (4 years), April 12 (Barrie); earliest, March 28, 1938 (Big Cedar Point).

♂ August 16, 1927, DeGrassi Point.*

79. **Wilson's Snipe.** *Capella delicata.*—A fairly common spring and fall transient and summer resident; breeds. This inhabitant of our marshes and wet meadows is somewhat more common than the last

species. Spring migrants arrive soon after mid-April. Ten were seen at Minesing on April 19, 1938, by Mr. D. S. Miller, and Mr. W. W. Gunn saw two at Midland on April 21, 1939. The courtship flight of this species with its accompanying winnowing sound is a familiar sight over many of our marshes. On June 12, 1939, six birds were observed performing at the same time over the Holland River Marsh. In an early account Small (1866) states that "Very good snipe-shooting is to be had in the peat-bogs on the Holland River Marsh." Mr. W. W. Campbell informed me that Wilson's Snipe were plentiful in this marsh during the fall of the year in the period around 1890. He recalled having seen sixty shot in one day by a hunting party.

An interesting winter occurrence for this species at Barrie has been reported in *Forest and Stream* by Beatty (1884). He states: "Allow me to tell you about a Wilson's Snipe shot here on January 23, 1884, by a Mr. Vair on his stream, Barrie, Ont., and where we have three feet of snow and the thermometer 36 degrees below zero. A more perfect bird I never saw; it was in good plumage and as fat as butter."

Records of its nesting at Cranberry Lake on June 10, 1928, by Dr. Harrington; at Minesing on June 7, 1927, by Drs. Harrington and Starr; and at Marl Lake on May 25, 1936, by the writer have been published by Baillie and Harrington (1936). A nest of four eggs was found by Mr. H. P. Bingham on May 22, 1940, at Little Lake. Mr. W. V. Crich found a nest containing four eggs in the Holland River Marsh on June 2, 1940. Its occurrence in summer has also been noted at Otter Lake (June 17, 1935) and at Waubaushene (June 15, 1939).

The fall migration takes place during August, September and October (latest, October 31, 1937). A flock of ten was flushed from the marsh at Collingwood on October 9, 1939; and Dr. Brereton saw fifteen birds at Barrie on October 26, 1940, and seventeen at the mouth of Batteaux Creek on September 27, 1941.

Average date of spring arrival (5 years), April 26 (Barrie); earliest, April 18, 1940 (Barrie).

? September 20, 1930, Little Lake.* ♂ August 1, 1938, Wasaga Beach.
♂ May 16, 1931, Minesing.*

80. **Hudsonian Curlew.** *Phaeopus hudsonicus.*—A rather rare spring and fall transient. On May 24, 1941, a flock of fifty-five birds was observed flying north over Big Cedar Point, Lake Simcoe, by Mr. W. W. Smith. By an odd coincidence, Mr. D. S. Miller saw what would seem to be the same flock of fifty-five individuals later in the day, flying northwest over Oro, some twelve miles due north of the first location. A large movement was witnessed by Mr. R. A. Smith at Holland River

on May 27, 1942, when flocks of 200 and 350 birds were seen passing over, flying northward.

Early fall migrants appear during July. A single individual was observed at Two Mile Point, Wasaga Beach, on July 14, 1935. A specimen taken there by Dr. Brereton on August 18, 1939, is now in the writer's collection. Mr. John Crosby reported seeing one at the mouth of the Holland River, Cook's Bay, on July 16, 1940. A mounted specimen in the Barnes collection was taken at Collingwood about 1920.

♂ August 18, 1939, Wasaga Beach.

81. **Upland Plover.** *Bartramia longicauda.*—An uncommon summer resident; breeds. This rather locally distributed species frequents grassy pasture land. Greatly reduced in numbers by overshooting at the turn of the century, the Upland Plover, under the protection provided by the Migratory Birds Convention Act, is now on the increase.

Spring migrants arrive about May 1. The nesting season over, departure for the south gets underway in July and by the end of August, practically all have left the county.

This species has been discovered breeding in four localities. Six or more pairs have been found summering near Oro Station in recent years, and a nest with four eggs was located there on July 1, 1937, by Mr. D. S. Miller. Dr. P. Harrington saw a young bird on the highway near Midhurst on June 29, 1935 (Baillie and Harrington, 1936); and a colony of at least three pairs was located nearby by Dr. Brereton on June 25, 1939. What was evidently a young bird of the year was seen perched on a fence post near Lisle on July 15, 1939. It allowed close approach and only flew when apparently urged to do so by both greatly excited parents. Adults with young birds were encountered at Big Cedar Point on June 15, 1940, and a nest of four eggs found by Mr. W. W. Smith on June 14, 1942. Near Hillsdale, on June 12, 1938, Mr. R. D. Ussher and the writer came upon an agitated pair, which from their actions were undoubtedly nesting. Other summer occurrences include: one observed at Collingwood during July, 1931, by Dr. Harrington (MS); individuals seen in June, 1933 and 1934, in Sunnidale township; and two apparently well established pairs at Marl Lake by the writer on June 17, 1941.

Average date of spring arrival (4 years), April 29 (Barrie); earliest, April 27, 1940 (Barrie).

♂ June 23, 1939, Oro Station.

82. **Spotted Sandpiper.** *Actitis macularia.*—A common transient and summer resident; breeds. This little sandpiper with the teetering habit

is a well-distributed species throughout the county, frequenting the shores of lakes, rivers and streams. Spring arrivals usually put in an appearance about May 1, and a few have been recorded in late April. The peak of the movement is reached in mid-May.

In the latter part of July, family groups augmented by the addition of early fall migrants produce flocks composed of twenty to twenty-five individuals. By September 1 it has become relatively rare. An individual noted at Oro Station on September 23, 1941, by Mr. D. S. Miller constitutes our latest autumn record.

The Spotted Sandpiper is a fairly common breeding bird in all parts of the county. The earliest date for a nest with the full complement of four eggs is May 15 (1939), when one was found near Lisle by Mr. J. C. Hall. At Two Mile Point, Wasaga Beach, three nests containing four, three and four eggs, respectively, were found within a comparatively small area on June 5, 1937; young have been noted as early as June 22 (1934). The nesting season extends well into July, and small, flightless young have been seen as late as August 2 (1936), at Duntroon. On June 10, 1937, a nest containing two eggs was found on Giant's Tomb Island. Revisiting the nest on the following day, the writer was just in time to see a Fox snake devouring the last remaining egg.

Average date of spring arrival (10 years), May 5 (Collingwood); earliest, April 26, 1940 (Barrie).

♂ May 20, 1888, Orillia.*
♀ May 21, 1932, Wasaga Beach.*
♀ June 1, 1932, Little Lake.*
Juv. ♂ August 1, 1936, Wasaga Beach.

83. **Solitary Sandpiper.** *Tringa solitaria.*—An uncommon spring and fall transient. In spring, this species appears about mid-May, usually as individuals or in small groups of three or four birds. It seems to avoid sand beaches, preferring instead the shores of quiet woodland ponds, small lakes and streams. A bird seen on June 4, 1928, at Jack's Lake by Messrs. Baillie and Harrington establishes a late date for spring.

Southbound migrants have been noted at Barrie on August 1 (1939). At Ferndale Pond, Barrie, eight were observed by Dr. Brereton on September 17, 1939, and three were observed there on September 24, 1939, by Dr. E. L. Brereton, D. S. Miller and the writer. An individual seen at Barrie by Dr. Brereton on October 18, 1939, is our latest autumn record.

Specimens taken are referable to the eastern form *T. s. solitaria.*

Average date of spring arrival (8 years), May 16 (Barrie); earliest, May 3, 1942 (Big Cedar Point).

♂ August 1, 1887, Severn River,
East Branch.*
♂ May 15, 1925, Little Lake.*
♀ May 22, 1938, Minesing.

84. **Willet.** *Catoptrophorus semipalmatus.*—A very rare fall transient; one record. On September 2, 1934, Mr. Charles Molony and the writer had the good fortune to discover one of these large waders feeding in shallow water at the edge of Collingwood harbour. Approaching to within 50 feet, we obtained an excellent view of this rare visitor. When the bird finally flew, the flashing black and white wing pattern left no doubt as to its identity.

85. **Greater Yellow-legs.** *Totanus melanoleucus.*—A fairly common spring and fall transient. In spring, this large shorebird is found frequenting temporary field ponds as well as beaches. In the autumn, after these ponds have dried up, it keeps more to the shores of lakes, rivers and marshes. It arrives in late April, somewhat earlier than the majority of other waders. The peak of the movement is reached during the first week of May, and by May 20, practically all have passed through the region. A flock of thirty-two was seen at a field pond at Minesing on May 1, 1938, and Dr. Brereton reported forty near Little Lake on May 4, 1939.

A few southbound migrants appear in late summer (Barrie, August 12, 1939), but the greatest numbers pass through during September and October. Stragglers have been observed in early November. On November 18, 1939, an individual, evidently handicapped by an injury, was seen by Dr. Brereton at Barrie. A specimen in the Barnes collection was taken at Collingwood about 1910.

Average date of spring arrival (6 years), May 2 (Barrie); earliest, April 23, 1939 (Bradford).

♂ May 1, 1932, Little Lake.* ♂ October 15, 1936, Wasaga Beach.

86. **Lesser Yellow-legs.** *Totanus flavipes.*—An uncommon spring and fall transient. Based on actual records this species is less common than the Greater Yellow-legs. It is more frequently observed during the southward flight than in spring. Arrives about the first week of May and has been recorded as late as May 20 (1939), at Barrie. Dr. Brereton saw a flock of thirty individuals at a temporary pond near Little Lake, May 5, 1939.

Southbound migrants have been noted as early as July 19 (1936), at Wasaga Beach; and a flock of six birds was seen at Edward's Lake, in the Blue Mountains, August 2, 1936. The Lesser Yellow-legs appears to pass through more rapidly in migration than the preceding species, the peak of the movement occurring in August, with a few stragglers remaining into early September (latest, September 3, 1934, Collingwood).

Thurston (1892) reported collecting "three Yellow-legs, *Totanus flavipes*" at Holland River, August 15-19, 1890. A specimen taken at Barrie by Dr. Brereton on August 1, 1939, is in the writer's collection.

Average date of spring arrival (5 years), May 6 (Barrie); earliest, May 1, 1943 (Little Lake).

♂ August 1, 1939, Barrie.

87. **Knot.** *Calidris canutus.*—An uncommon spring and fall transient. In spring, the Knot is one of the last shorebirds to arrive from the south, being seldom observed before June 1. Its stay with us is of short duration and by June 11, practically all have moved northward. Mr. J. L. Baillie reported twenty-six at Wasaga Beach on June 6, 1929; and a flock of fifteen was observed at Oakview Beach on May 31, 1936, by Mr. C. Molony and the writer.

Few have been recorded during the southward flight. Our earliest fall date is August 26 (1942), on which occasion two individuals were noted at the mouth of the Nottawasaga River. Of a flock of ten birds observed in this same locality on August 31, 1940, four were still present on September 1. A male specimen in the writer's collection taken by Dr. Brereton on October 4, 1941, at Wasaga Beach constitutes a late occurrence record.

Average date of spring arrival (8 years), June 4 (Wasaga Beach); earliest, May 23, 1942 (Wasaga Beach).

♀ June 3, 1939, Wasaga Beach. ♂ October 4, 1941, Wasaga Beach.

88. **Pectoral Sandpiper.** *Pisobia melanotos.*—A very rare spring and an uncommon fall transient. The only spring record for this species is that of a group of three birds observed at McLean's Pond, near Little Lake, by Dr. Brereton on May 4, 1939.

It is noted regularly, but in small numbers, during the fall. The southward flight begins in July. Mr. R. A. Smith reported an individual at Wasaga Beach on July 22, 1934. A specimen taken from a flock of ten at Wasaga Beach on August 1, 1936, was in a very fat condition. The movement continues throughout September and well into October. Our latest fall record is that of a specimen shot at Little Lake by Mr. H. B. Haugh on October 29, 1925.

? October 29, 1925, Little Lake.* ♂ August 1, 1936, Wasaga Beach.

89. **White-rumped Sandpiper.** *Pisobia fuscicollis.*—A rare spring and fall transient. On May 4, 1939, Dr. Brereton observed two White-rumped Sandpipers at McLean's Pond, near Little Lake; and the same

observer encountered two individuals in a wet field, near Wasaga Beach, on October 13, 1941. Two mounted specimens taken by Mr. William Bush about 1860 at Fesserton, have been examined by the writer.

90. **Baird's Sandpiper.** *Pisobia bairdi.*—A rather rare fall transient; no spring records. This small wader has been detected on a few occasions in the late summer at Wasaga Beach. It is usually found associated with other shorebirds such as Semipalmated Sandpipers.

Southbound migrants appear during the latter part of August (earliest, August 29, 1936). The average fall arrival date at Wasaga Beach for six years is September 2. A flock of five birds was encountered at Two Mile Point, Wasaga Beach, on August 31, 1935. A specimen taken at this point on September 21, 1935, constitutes our latest autumn record.

♀ August 31, 1935, Wasaga Beach. ♂ September 21, 1935, Wasaga Beach.

91. **Least Sandpiper.** *Pisobia minutilla.*—A common spring and fall transient. This diminutive shorebird can be expected after the middle of May. At this season, it is found frequenting mud flats, temporary field ponds and beaches. By June 1, the majority have moved northward.

A considerable increase in numbers over the spring flight is apparent during the autumn migration. The Least Sandpiper is usually among the first shorebirds to reappear from the north after the breeding season, Southbound migrants have been noted on July 13 (1941) at Wasaga Beach. From this date onward the species increases in abundance and flocks of fifty or more birds are not unusual. A gradual lessening of numbers is evident after September 1, and none have been recorded after September 24.

Average date of spring arrival (4 years), May 22 (Wasaga Beach); earliest, May 15, 1938 (Minesing).

? August 31, 1887, Orillia.* ♂ May 24, 1935, Wasaga Beach.

92. **Dunlin.** *Pelidna alpina.*—A common spring and fall transient. The Dunlin (or Red-backed Sandpiper) arrives in late May. At this season, flocks containing upwards of fifty individuals are found frequenting beaches and mud flats. At McLean's Pond, near Barrie, Dr. Brereton observed a flock of twenty-five birds on May 20, 1939. By the end of the first week of June, all except a few stragglers have moved northward. An individual seen by Dr. Harrington on June 12, 1928, at Wasaga Beach, marks a late spring occurrence.

A rather belated migrant in the fall, the Dunlin reappears after most other shorebirds have departed. Southbound transients have been noted at Wasaga Beach by October 3 (1937), and the species continues common until the end of the month. At the aforementioned place, over one hundred birds were seen on October 15, 1936. A few stragglers linger into November (latest, November 25, 1942, Brereton).

Atkinson (1892) states that three were seen at Holland River on October 26, 1890. A specimen taken by Dr. F. A. E. Starr at Wasaga Beach on October 22, 1922, is in the R.O.M.Z.

Average date of spring arrival (8 years), May 22 (Wasaga Beach); earliest, May 16, 1941 (Wasaga Beach).

♂ October 22, 1922, Wasaga Beach.*
♀ May 25, 1936, Wasaga Beach.
♀ May 24, 1938, Wasaga Beach.
♀ November 8, 1941, Wasaga Beach
♂ November 25, 1942, Wasaga Beach.

93. **Dowitcher.** *Limnodromus griseus.*—A rare spring and fall transient. On June 6, 1927, a flock of thirty Dowitchers in company with Ruddy Turnstones was observed at Wasaga Beach by Dr. Harrington (MS). A flock of six birds observed at the mouth of Batteaux Creek, Collingwood, on May 22, 1939, constitutes our earliest spring record.

On September 3, 1934, five individuals were found feeding along the shore at Collingwood and a single male specimen secured. The measurements in millimetres of this bird (wing 143.7; bill 56.2; tarsus 31.2) besides other features of plumage indicate that it falls within the limitations ascribed to the proposed new race *hendersoni* of Rowan (1932), the so-called Inland Dowitcher.

♂ September 3, 1934, Collingwood.

94. **Semipalmated Sandpiper.** *Ereunetes pusillus.*—A common spring and fall transient and a rare summer visitant. This is probably our commonest transient shorebird. It appears soon after mid-May and remains common until well into June, frequenting beaches, mud flats and temporary field ponds. Eight were observed at McLean's Pond, near Barrie, by Dr. Brereton on May 16, 1940. Well over one hundred birds in scattered flocks were noted along Wasaga Beach on June 1, 1939. Seven were present on Giant's Tomb Island on June 11, 1937. A few individuals noted in late June (June 20, 1937) and early July (July 1, 1938) were probably non-breeding birds.

The southward migration is underway by mid-July and the species is regularly observed in groups of from two to thirty birds until well into October (latest, October 16, 1936).

Average date of spring arrival (7 years), May 23 (Wasaga Beach); earliest, May 16, 1940 (Barrie).

♀ May 26, 1930, Little Lake.*
♂ July 21, 1935, Wasaga Beach.
♀ July 21, 1935, Wasaga Beach.

Hypothetical—

Western Sandpiper. *Ereunetes mauri.*—There is but one sight record for this rare straggler from the west, that of a single individual observed at Wasaga Beach by Dr. and Mrs. L. E. Jaquith on October 8, 1941. In view of the rarity of this species in Ontario and pending further corroborating evidence it has been placed on the hypothetical list.

95. **Sanderling.** *Crocethia alba.*—An uncommon spring and very common fall transient. The Sanderling seldom strays far from the sand beach and during migration it is almost entirely confined to this type of habitat. On the broad expanse of Wasaga Beach it finds feeding grounds to its liking and appears there in considerable numbers during the autumn migration.

In spring, this species occurs regularly but in small numbers. The first migrants arrive during the latter part of May and a few linger on into the first week of June (latest, June 4, 1939).

Early returning individuals of the southward movement have been noted at Wasaga Beach on July 21 (1935), on which date a specimen was taken from a flock of fifteen birds. The greatest concentrations are reached in late September and the first half of October when groups containing from ten to two hundred birds have been observed. In November, when most shorebirds have long since departed, small groups of Sanderlings are occasionally seen searching industriously along the beach (latest, November 6, 1932).

Average date of spring arrival (5 years), May 23 (Wasaga Beach); earliest, May 16, 1941 (Wasaga Beach).

♀ July 21, 1935, Wasaga Beach. ♂ October 18, 1941, Wasaga Beach.*

96. **Red Phalarope.** *Phalaropus fulicarius.*—A very rare fall transient. This species has been recorded upon three occasions. A specimen taken by Mr. H. B. Haugh at Little Lake on November 12, 1931, is in the R.O.M.Z. On October 13, 1936, the writer secured a specimen in winter plumage at Two Mile Point, Wasaga Beach. At this same point, Mr. A. Van succeeded in photographing an individual on November 15, 1936.

? November 12, 1931, Little Lake.* ♀ October 13, 1936, Wasaga Beach.

97. **Wilson's Phalarope.** *Steganopus tricolor.*—A very rare spring and fall visitant. The Wilson's Phalarope has been recorded on but two occasions. On September 4, 1921, one was seen swimming and feeding on some form of water insect in the Nottawasaga River, near Oakview, by Dr. Harrington (MS). A single individual was observed by Dr. Brereton on May 15, 1939, at McLean's Pond, near Barrie.

98. **Northern Phalarope.** *Lobipes lobatus.*—A very rare fall transient. On September 19, 1937, an individual which was associating with a flock of Sanderlings was secured at Wasaga Beach. Dr. Brereton observed a single bird at Kempenfelt Bay on October 27, 1940. Two mounted specimens in fall plumage in the Barnes collection, taken at Collingwood about 1910, were examined by the writer.

♀ September 19, 1937, Wasaga Beach.

99. **Parasitic Jaeger.** *Stercorarius parasiticus.*—A rare fall visitant. The inclusion of this species is based on several sight records. On September 22, 1935, while watching gulls at Three Mile Point, Wasaga Beach, the writer observed a dark coloured jaeger, believed to be of this species, passing westward in an irregular hawk-like flight. The light areas at the base of the wings were clearly visible and the absence of projecting tail feathers added to the belief that it was probably an immature bird. Mr. R. D. Black reported observing three jaegers, believed to be of this species, off Jackson's Point, Lake Simcoe, on September 13, 1939.

100. **Long-tailed Jaeger.** *Stercorarius longicaudus.*—An accidental visitant. In November, 1913, an individual of this species was shot at Lake Simcoe, in Innisfil township, by Mr. W. E. Playter. The specimen now in the R.O.M.Z. collection constituted the first definite record for the species in Ontario.

? November, 1913, Innisfil township.

101. **Glaucous Gull.** *Larus hyperboreus.*—A casual winter visitant. This large gull has been detected on a few occasions on Lake Simcoe in winter. One was seen by Dr. E. L. Brereton at Barrie on January 2, 1939, and another on December 15, 1940. On December 26, 1940, another or possibly the latter individual was seen on Kempenfelt Bay, off Minet's Point, by Dr. Brereton and the writer. It was in company with a large flock of Herring Gulls and appeared to be an immature in the buffy plumage of the first winter.

It is of interest to note that a specimen of the Glaucous Gull in the R.O.M.Z. collection was found dead on the ice in Lake Simcoe, off Port Bolster, Ontario County, by Mr. F. Hurst in April, 1933.

102. **Herring Gull.** *Larus argentatus.*—A common transient and summer resident; uncommon winter visitant; breeds. This gull has been observed in every month of the year. During mild winters, flocks

of one hundred or more birds are to be found on Lake Simcoe in places where open water is available. In severe winters, practically all disappear, the exception being a few individuals that remain about some of the larger towns where garbage dumps provide a source of food. During 1940-41, several wintered around Barrie despite rather severe weather conditions.

In late March and early April, migrating flocks numbering fifty to one hundred birds may be seen flying northward, even before the lakes have opened up. While the great majority pass through the region to the islands of Georgian Bay, numbers of non-breeding gulls are always present on the larger lakes and bays during the summer months.

The Herring Gull is known to breed regularly in only one locality in the county. On Gull Island, in Georgian Bay, off Tiny township, a few pairs nest each year near a large Ring-billed Gull colony. Lawrence (1927) reported finding a set of three eggs on this island on July 15, 1927. Mr. H. P. Bingham collected a set of three eggs on June 8, 1930, and Mr. R. Pyle found three nests with eggs on May 15, 1938. Mr. H. H. Southam visited the island on June 18, 1939, and banded three young; and again on June 23, 1940, two large young were banded.

A nest of this species in an unusual situation was found by Dr. Harrington on June 6, 1926. It was built on top of an old stump that had lodged on a sandbar at the mouth of the Nottawasaga River; the nest contained one egg (MS).

Lincoln (1927) records that a specimen which had been banded at Green Bay, Wisconsin, on July 9, 1926, by Wm. I. Lyon was found dead at Orillia on October 1, 1926.

♀ July 1, 1932, Wasaga Beach.

103. **Ring-billed Gull.** *Larus delawarensis.*—A common transient and summer resident; breeds. In spring, this species usually arrives in April. Transient flocks are often to be seen resting or feeding in wet fields. On April 30, 1934, a flock of twenty-one was observed at Stroud; and Mr. W. V. Crich found fifty near Little Lake on April 24, 1938. A migrating flock numbering approximately three hundred individuals was seen in a flooded field bordering the Nottawasaga River, a few miles north of Angus, on May 11, 1941.

The fall migration is heralded by the appearance of immature birds in late July and early August along some of the more southern beaches, notably Wasaga Beach where two to three hundred may be seen daily during August. The southward movement reaches its maximum during September and October when flocks numbering one hundred or more have been recorded. After November 1, only a few birds are to be found.

Brereton and Laws (1942) reported five individuals at Barrie on December 26, 1941.

In summer, it is a common resident of the northern townships bordering Georgian Bay and scarce elsewhere in the county. An old established breeding colony exists on Gull Island, in Georgian Bay, off Tiny township. Information concerning the location of this colony was first conveyed by Mr. D. F. Jamieson of Barrie to C. B. Lawrence (1927) who visited the island on July 15, 1927, and noted "hundreds of young gulls running around." Mr. H. P. Bingham collected a set of four eggs there on June 17, 1928. The writer visited the island on June 7, 1937, and found about three hundred nests containing eggs and newly hatched young. By August 1, most of the young were on the wing. In recent years, bird banding has been carried on at this colony by Messrs. H. H. Southam and G. Lambert. On June 18, 1939, they banded three hundred and fifty-nine young Ring-billed Gulls. A considerable increase in the size of the colony was noted on their visit of June 23, 1940. Of an estimated population of 2,500 young gulls they succeeded in banding 1,300 individuals. As a result of this work some one hundred recoveries have been received to date (1942), seventeen of which are from Florida. An indication of the migration route taken by first-year birds to reach their wintering grounds may be gained from the information at hand. After leaving Gull Island the young scatter to some extent but the general direction of the movement is towards the southeast. In 1939, immatures with bands were observed at Wasaga Beach on August 5. By August 15, some have reached Lake Ontario (Bloomfield, Prince Edward County); by August 25, New York State (Onondaga Lake). The route then appears to dip to the south through Pennsylvania (Gilfoyle), Virginia (Back Bay) and South Carolina (Hand) to Florida, which is reached by late November (Lake Apopka, November 26; Orlando, November 27). Other Florida returns include a banded gull found dead at Coronado Beach on December 21, 1939; one found crippled at West Palm Beach on March 30, 1940; and one killed by an automobile at Key Largo on February 12, 1941. Two individuals banded on June 23, 1940, were later caught at Tanamo Bay, Cuba, December 8, 1940, and Kingston, Jamaica, June 9, 1941, respectively.

Average date of spring arrival (5 years), April 20 (Barrie); earliest, March 27, 1938 (Wasaga Beach).

♂ October 20, 1934, Wasaga Beach.
Yg. ? June 7, 1937, Gull Island.
Imm. ♀ September 5, 1938, Wasaga Beach.

104. **Franklin's Gull.** *Larus pipixcan.*—A casual visitant; one record. This wanderer from the prairies has been detected in the county

on but one occasion. On August 31, 1936, the writer secured a specimen at Wasaga Beach (Devitt, 1937). This bird was in company with a flock of Ring-billed Gulls at the time and proved to be a female in transition between the first-nuptial and second-winter plumage.

♀ August 31, 1936, Wasaga Beach.*

105. **Bonaparte's Gull.** *Larus philadelphia.*—A fairly common spring and fall transient. This graceful little gull can be looked for about mid-May. Spring dates range from May 11 to May 29, and include a flock of twenty seen on May 15, 1939, by Dr. Brereton at Little Lake; ten observed at Wasaga Beach on May 22, 1939; and forty at Barrie on May 11, 1941, by Mr. D. S. Miller and the writer. Occasional non-breeding birds have been recorded in summer.

The fall movement extends over a longer period than that of the spring. Dr. Harrington has seen immatures at Wasaga Beach as early as August 5 (1934), but the peak of the migration is not reached until late September and October. An immature was taken from a flock of seventy-five at Wasaga Beach on October 16, 1936. November occurrences include six birds at Collingwood, November 1 (1939); fifteen at Barrie, November 4 (1939); and six at Orillia, November 29 (1942), (Brereton). Our latest fall date is December 7 (1938), when six were noted at Barrie by Dr. Brereton.

At Holland River, on October 18, 1890, Atkinson (1892) recorded that "a large flock of Bonaparte's Gulls, *Larus philadelphia* was seen and several specimens secured."

Average date of spring arrival (4 years), May 20 (Wasaga Beach).

Imm. ♀ October 16, 1936, Wasaga Beach.

106. **Forster's Tern.** *Sterna forsteri.*—A very rare fall transient. A single individual of this species, in immature plumage, possessing the characteristic black patch through the eye and ear, was satisfactorily identified by Dr. Brereton at Wasaga Beach, on October 4, 1941, as it rested on a sandbar within 40 yards of the observer.

107. **Common Tern.** *Sterna hirundo.*—A common transient and summer resident; breeds. The first spring migrants appear in late April, and by May 12, the species has become common.

The southward movement commences towards the latter part of August. What appeared to be a general exodus was witnessed on September 1, 1940, at Wasaga Beach, when a flock of one hundred and seventy-five was seen to depart overland in a south westerly direction;

the next day only five birds could be found. Groups of fifty or more have been seen in September on Lake Simcoe, and by October 1, only a few stragglers remain. The latest fall record is that of two birds seen at Wasaga Beach on October 13, 1940.

Several nesting colonies exist on islands in Georgian Bay. A small colony was found on Cobblestone Island, off Collingwood on July 2, 1923, by Dr. Harrington who collected a set of three eggs (in R.O.M.Z.) (Baillie and Harrington, 1936). During a visit to this island on May 31, 1936, the writer examined twenty-five nests with incomplete sets of eggs indicating that laying had just started. Lawrence (1927) found "a colony of well over two hundred nests" on Gull Island, in Georgian Bay, off Tiny township, on July 15, 1927. When visited by the writer on June 20, 1937, this colony contained one hundred and fifty nests with eggs and incubation was in progress. By August 1, most of the young were on the wing. There appeared to be a high mortality among the young terns. Many of the dead examined seemed to have suffered head injuries which may have been caused by adult Herring or Ring-billed Gulls, both of which nest nearby. The statement made by Lawrence (1927) that Forster's Terns also breed on this island seems undoubtedly a case of mistaken identity as to the species. On June 10, 1937, twenty Common Terns were seen on Giant's Tomb Island and although no direct evidence was secured, they are strongly suspected of breeding at the northern point of the island. A small colony is believed to exist on a small islet off Methodist Island, as twenty pairs were observed continually alighting or hovering over this spot on June 15, 1939.

Thurston and others (1892) reported observing Common Terns at the mouth of the Holland River, August 15-19, 1890.

Average date of spring arrival (14 years), May 12 (Collingwood); earliest, April 23, 1943 (Barrie).

? September 20, 1930, Little Lake.* Imm. ♀ August 1, 1937, Gull Island.

108. **Caspian Tern.** *Hydroprogne caspia.*—A fairly common spring and uncommon fall transient; an uncommon summer resident. The first spring arrivals usually appear the latter part of April. By mid-May, the species is fairly common. Each spring, a flock which varies from twenty to fifty individuals regularly spends from three to four weeks at the mouth of the Nottawasaga River. A flock of twenty-six was observed to be still present at that place on June 13, 1939, by Mr. W. W. Gunn, but as a rule, the northward movement is continued and they leave the situation about the end of the first week of June.

Occasional non-breeding birds are to be found in the county during the summer months. A few are present each summer at Wasaga Beach and Marl Lake, and others have been observed at such widely separated localities as St. George's Lake (June 17, 1939); Oro (July 13, 1936); Waubaushene (June 16, 1939); and Christian Island (August 10, 1931). Mr. G. C. Toner noted it at Midland from August 3 to 8, 1931.

The fall migration is not well defined but evidence of a southward movement has been noted about September 1. Three individuals were seen at Three Mile Point, Wasaga Beach, on September 3 (1939), and immatures have been-observed on September 5 (1937). Four seen at Collingwood on September 6 (1937), is our latest autumn record.

A male specimen taken by J. L. Baillie at Wasaga Beach on June 3, 1928, had been banded by F. C. Lincoln at St. James, Michigan, on July 19, 1925 (Can. Field-Nat., Feb., 1929, p. 43).

Average date of spring arrival (11 years), May 7 (Collingwood); earliest, April 26, 1942 (Wasaga Beach).

♂ June 3, 1928, Wasaga Beach.*
♂ May 21, 1932, Wasaga Beach.*
♀ May 21, 1932, Wasaga Beach.*
♂ May 19, 1935, Wasaga Beach.

109. **Black Tern.** *Chlidonias nigra.*—A fairly common transient and summer resident; breeds. This species arrives back from the south about the second week of May to occupy suitable breeding territory in marshes and lakes with marshy margins throughout the county. Nests with fresh eggs have been found at Marl Lake as early as May 20 (1922) (Baillie and Harrington, 1936). Drs. Harrington and Starr (1923) discovered a colony at the latter lake on June 15, 1921. Some sixteen nests were located and about one hundred pairs were estimated to be breeding. A gradual and unaccountable decrease in the size of this colony has taken place since 1921; about thirty pairs bred there in 1929. On June 23, 1934, the writer counted fourteen pairs and found four nests with eggs and newly hatched young. In 1940, not more than four pairs summered in this area. That the colony at the mouth of the Holland River has been long established seems probable since Thurston and others (1892) noted "several young Black Terns flying about the marsh as if they [the species] had been breeding there" on August 15, 1890. Ussher (1939) found nests with eggs at this marsh on June 9, 1938, and estimated at least fifty breeding pairs. A small colony exists at Little Lake and a set of three eggs, in the R.O.M.Z., taken by H. B. Haugh on June 24, 1917, has been recorded by Baillie and Harrington (1936); a set of two eggs was found there by the writer on June 22, 1939. Fifty pairs were observed at Fesserton on June 16, 1939, and nine nests, containing either two or three eggs, located. At Grass Lake, ten or more pairs were

discovered breeding and nests with young just hatching noted on June 21, 1939.

The Black Tern is one of the first birds to depart for the south. In late July and early August, as soon as the young are on the wing, the southward movement is begun. An individual in winter plumage noted at the mouth of the Nottawasaga River on September 5, 1943, constitutes our latest autumn record.

Average date of spring arrival (5 years), May 13 (Barrie); earliest, May 8, 1938, (Big Cedar Point).

? August 21, 1919, Little Lake.*	Imm. ♂ July 19, 1936, Wasaga Beach.
? May 16, 1925, Little Lake.*	

110. **Thick-billed Murre.** *Uria lomvia.*—An accidental visitant.

One was shot at Big Bay Point, Lake Simcoe, about 1896, by Mr. R. J. Robinson who had the bird mounted. Through the kindness of Mr. Sprague Troyer the specimen was acquired for the writer. It appears to be an adult in winter plumage. Mr. A. D. Henderson of Belvedere, Alberta, former resident of Barrie, informed the writer that he shot six examples of this species on November 21, 1896, and saw a number of others on Kempenfelt Bay, Barrie.

? about 1896, Big Bay Point.

111. **Rock Dove.** *Columba livia.*—The domestic or farm pigeon originally introduced from Europe (where the Rock Dove was originally domesticated) has in most instances reverted to its former wild state and now lives independent of any direct aid from man. They are to be found around most farm buildings and a few are able to eke out a living in some of the towns of the county.

According to *Jesuit Relations* XXX, 153, eight pigeons were sent as New Year's gifts to the Jesuit Fathers at Sainte Marie, now marked by the Martyrs' Shrine near Midland, in 1647, by the governor of New France, Montmagny. The Ontario stock may well have originated from these birds.

112. **Mourning Dove.** *Zenaidura macroura.*—A fairly common transient and summer resident; a rare winter visitant; breeds. Spring migrants appear early in April, and there are several records for March. On April 15, 1938, twenty individuals were observed at Holland River. A few birds occasionally spend the winter in the county. Mr. Alfred Bunker saw three almost daily from November, 1939, to January, 1940, frequenting a cornfield at Midhurst; and Dr. E. L. Brereton reported

one at Barrie during the winter of 1939-40, associating with a flock of domestic pigeons.

This species is a fairly common breeding bird throughout the county, apparently raising two broods during the season. Nests with completed sets of two eggs have been found as early as April 24 (1938), at Big Cedar Point by Mr. W. W. Smith. The latter observer has upon several occasions discovered this species utilizing old robin's nests as nesting sites. The writer has found fresh eggs at Holland River, Bradford, as late as July 3 (1938), on which occasion an exceptional set of three eggs was secured. Starr (1923) described the species as fairly common in the South Georgian Bay region and reported finding two nests with eggs on June 6, 1923. Nests at Collingwood, on June 3, 1928; Orr Lake, June 7, 1929; and at Mac, June 9, 1929, have been recorded by Baillie and Harrington (1936).

The main southward flights take place during September and early October, after which period the bird becomes rare. A few individuals remain into November, and as noted above, in some cases, throughout the winter.

Average date of spring arrival (5 years), April 10 (Bradford).

Juv. ♂ July 24, 1938, Holland River, Bradford.

113. **Passenger Pigeon.** *Ectopistes migratorius.*—A former abundant transient and summer resident, now extinct. The Passenger Pigeon occurred in Simcoe County in vast numbers both as a transient and as a breeding bird. Its disappearance was due primarily to man. The gradual reduction of the forest in eastern North America was a prominent factor, but wholesale shooting and trapping of the adults and the killing of the young squabs at the nesting colonies, year after year, with the resultant failure of an adequate breeding stock, certainly helped to hasten its final extinction.

The earliest reference to the Passenger Pigeon in the region is that mentioned by Father Gabriel Sagard who lived with the Huron Indians from 1623 to 1624 in what is now Tiny township. He speaks of "an immense number of turtle-doves . . . which feed in part on acorns." Head (1829) writes concerning its spring arrival at Kempenfelt Bay on April 4, 1815: "Shortly after daylight, in the morning, I heard a chattering of birds close to my house, as loud and incessant as if a thousand parrots had perched upon the neighbouring trees . . . . I soon perceived that a flock of wood pigeons had settled themselves all around about me . . . as I approached towards the busy gabbling which directed my course, the first that struck my eye were perched on the branches of a dead old tree, which was literally laden with them. I no sooner caught sight of them than they immediately rose, and this movement was the signal for legions of others, which I could not see, to do the same .... I shot at them as they rose ... and before breakfast bagged in all twenty-two birds."

The pigeons used to return from the south in late March and early April, the earliest arrival date for Kempenfelt Bay given by a "Correspondent" in the *Canadian Naturalist and Geologist* (1858) is March 19. He states: "On the afternoon of Friday, the 19th of March, immense flights of wild pigeons passed along the shores of Kempenfelt Bay (an arm of Lake Simcoe) flying generally in a westerly and north-westerly direction. One flock at fair computation was at least three miles long, and in the distance looked like a very large cloud rising gradually from below the horizon." Concerning the great flights of these birds, Mr. A. Debenham of Dalston writing in the *Family Herald* about 1912 states: "I have often heard my father speak of the pigeons being in vast abundance in his young days; and he said that once about fifty-four years ago [about 1858], they crossed the land in such unprecedented large numbers that for about four hours they shaded the sun, and as far as could be seen in any direction was only a mass of pigeons. There were besides, large flocks crossing all day, and they were all flying north-west."

Thompson (1884) referring to its occurrence in Sunnidale township, about 1840 says: "In spring the birds would come flying round the east shore of Lake Huron, skirting the Georgian Bay in such vast clouds as to darken the sun, and so swiftly that swan shot failed to bring them down unless striking them in rear .... I have known twenty-five pigeons killed at a single shot .... The pigeon-roost itself was a marvel. Men, women and children went by the hundred, some with guns, but the majority with baskets to pick up the countless birds that had been disabled by the fall of the great branches of trees broken off by the weight of their roosting comrades overhead. The women skinned the birds, cut off their plump breasts, throwing the remainder away, and packed them in barrels with salt for keeping."

The Passenger Pigeon was formerly an abundant breeding bird in the county. According to available records, it nested in the townships of Sunnidale, Innisfil, Essa, Vespra, Nottawasaga, Oro, West Gwillimbury and Flos. A history of this species in Ontario by Margaret H. Mitchell (1935) contains a number of references to breeding colonies in Simcoe County. Included is the statement of Mr. William Metcalf that "in the year 1859 they nested in a large swamp [Minesing] between Allandale and Angus, the colony covering hundreds of acres."

In a paper read before the Brodie Club of Toronto, January 22, 1929, the late Mr. John Townson told of a colony that had existed nine miles northeast of Barrie about 1865. He stated: "Father and Dr. Riddell paid a visit to the locality where the pigeons were nesting. The breeding ground chosen by the pigeons was a ridge covered with hardwood, mostly beech, with some maple, oak and birch. He stated that the birds were there literally in thousands, and he was inclined to be cautious when speaking of numbers . . . . He also said there were from four or five up to seventeen nests—the highest number he counted—on some of the trees. The nests were constructed on the nearly horizontal limbs, loosely-built affairs of broken twigs, generally containing two eggs but in some cases only one. The nests were usually built about fifteen feet from the ground upward." According to Small (1866) a "Pigeon Rookery" existed at Harrison's Crossing between Gilford and Lefroy. "Here in certain seasons the Passenger Pigeon congregates in thousands to breed, and is the object of pursuit to whoever is master of even a rusty firelock. April is the month in which to go out after them . . . . But it is only in certain seasons, about once in four or five years that they are numerous; probably the abundance of beech mast, the previous year, their principal food, attracting them and its absence compelling them to seek other quarters."

Major Mark Robinson in conversation with the writer said that he remembered seeing great numbers of pigeons nesting in Norway pines, which used to cover the sandhills two miles south of Wasaga Beach about 1870. Between 1850-1880 the species seems to have experienced a steady decrease in numbers. The great flocks became a thing of the past and after 1880, only small groups were recorded. Mr. Thomas Nash told me of shooting six out of a flock of twenty-five birds at the northern limits of Barrie about 1880. Mitchell (1935) quotes a letter from Mr. Chas. Hebner of Orillia who states: "I can distinctly remember the days when the Passenger Pigeon used to come and roost in the woods between the Nottawasaga and Pine Rivers. That was just sixty years ago [about 1875] and I was then a boy of seven or eight years of age. They came in vast numbers for two or three years and then the numbers began to diminish until they disappeared altogether when I was about fifteen [about 1883]." In September, 1885, Major Mark Robinson reported shooting two birds in Sunnidale township while grouse hunting and declared that these were the last shot by him in that section. His last observation of the species was in 1887, when he saw seven near Wasaga Beach. According to Fleming (1903) one of the last sight observations of the Passenger Pigeon was made at Penetanguishene by Mr. A. F. Young, who saw one on May 16, 1902, and a pair on May 18, 1902.

Specimens taken in Simcoe County and whose present whereabouts are definitely known are as follows: A male taken about 1870 by a Mr. Harvie is in the R.O.M.Z.; two immatures shot at Barrie (date unknown) were donated to the R.O.M.Z. recently by Mr. H. P. Bingham; a specimen in the Huron Institute, Collingwood, was shot at Kirkville, a few miles west of Collingwood by Mr. J. Swain in 1870; a mounted specimen in the possession of Mrs. W. Thompson of Orillia, examined by the writer, had been shot about 1874 at North River, near Coldwater by Mr. Harry Ardagh of Orillia; a very fine mounted bird in the possession of Mr. H. Moran of Barrie was taken locally by his father about 1885; a specimen now owned by Mr. Fred Smith of Fesserton was taken locally and mounted by the late Mr. William Bush about 1860.

114. **Yellow-billed Cuckoo.** *Coccyzus americanus.*—A rare transient and summer resident; breeds. The Yellow-billed Cuckoo has been found on several occasions in the vicinity of Lake Simcoe, in the townships of Innisfil and Oro, and probably occurs erratically along the southern border of the county. One was observed by Mr. W. W. Smith at Big Cedar Point during the summer of 1938. On August 4, 1939, a nest of this species containing two young and one egg was found by Mr. G. Lambert in the ninth concession of Innisfil township. Messrs. D. S. Miller and G. Giles saw a single individual at Oro Station on September 22, 1941.

115. **Black-billed Cuckoo.** *Coccyzus erythropthalmus.*—A fairly common transient and a well-distributed summer resident; breeds. The Black-billed Cuckoo is a rather late spring arrival usually appearing about the third week of May.

In 1938, during an infestation of tent caterpillars in the Severn Falls-Tea Lake area, this species, one of the few birds that will eat tent caterpillars, was observed to be present in considerable numbers from June13 to June 18.

A nest containing four eggs was found by the writer, three feet up in a small hawthorn, at Wasaga Beach on June 29, 1922. A set of three eggs found at Marl Lake on June 8, 1929, has been recorded by Baillie and Harrington (1936). A rather late breeding record was obtained on August 6, 1933, when a nest with two eggs was located on a small island in the Nottawasaga River, near Oakview. Small young in the nest have been found as early as June 17 (1939), by Mr. W. W. Smith at Big Cedar Point; and Dr. E. L. Brereton observed a fledgling, out of the nest, being fed by an adult on June 25 (1939), at Midhurst.

An individual seen at Holland River on September 15, 1940, constitutes our latest fall record. A specimen taken by Mr. J. Edmonds at Hawkestone on May 26, 1890, is in the R.O.M.Z.

Average date of spring arrival (5 years), May 22 (Barrie); earliest, May 5, 1939 (Holland River).

♀ May 26, 1890, Hawkestone.*	♂ June 18, 1938, Severn Falls.
♂ May 21, 1930, Little Lake.*	♂ August 12, 1938, Barrie.

116. **American Screech Owl.** *Otus asio.*—A fairly common permanent resident; breeds. Hasbrouck (1892) mentions its occurrence near Orillia (Ardtrea) on the authority of John Blair as one of the records which indicate the northern limits of its range in North America. In the Holland River area, it is frequently heard calling at night from May to October.

An observation by Dr. Harrington of five young, recently out of the nest, at Wasaga Beach on July 17, 1920, has been recorded by Baillie and Harrington (1936). A young bird, as yet unable to fly, was caught by Mr. J. W. Gossling at Little Lake on June 20, 1937, and kept in captivity for some months. The specimen was later secured by Dr. Brereton and is now in the writer's collection.

This species occurs is either grey or red plumage, with the red-phased individuals being rather rare. One in the red phase was observed at Wasaga Beach on August 1, 1925. Mr. J. Steele of Allandale is in possession of a mounted red-phased specimen which was secured by Mr. K. Rayner in 1934, at Big Bay Point. Mr. J. C. Hall (MS) reports having knowledge of a nest, found in Tossoronto township in 1939, which contained four large young of which two were red- and two grey-phased.

Mounted specimens are in the Debenham collection at Dalston and in the Barnes collection at Collingwood.

♀ June 20, 1937, Little Lake.

117. **Horned Owl.** *Bubo virginianus.*—A fairly common permanent resident. This species is well distributed throughout the county and few heavy stretches of woodland are without a pair of Horned Owls.

Breeding specimens are referable to the form *B. v. virginianus* while specimens of the more northern race *B. v. subarcticus* have been taken occasionally during the winter. In his notes, the late Mr. J. H. Fleming records having examined "two Arctic Horned Owls (*B. v. subarcticus*) from Bradford on November 7, 1907." A mounted specimen in the Debenham collection taken at Dalston about 1900, also appears to represent this more northern form.

The Horned Owl is one of the first birds to breed in the spring and nests with eggs have been found at Little Lake as early as March 13 (1932), by Mr. H. P. Bingham. A set of two eggs (in R.O.M.Z.) taken by H. B. Haugh at Barrie on March 18, 1923, and a nest with two young seen on May 9, 1925, at Minesing have been recorded by Baillie and Harrington (1936). A nest discovered by Dr. Brereton at Little Lake, sixty feet up a sugar maple, was examined by the writer on April 24, 1938, and found to contain one half-grown young owlet. Food items noted in the nest included one house rat, one partly eaten cottontail and many feathers of starlings. On May 28, the young owl was noted flying about in the vicinity of the nest.

As might be expected, this species is well represented by mounted specimens in the various county collections.

♀ December 10, 1930, Minesing.* ♀ February 25, 1938, Midhurst.
♀ August 8, 1933, Crown Hill.*

118. **Snowy Owl.** *Nyctea nyctea.*—An irregular winter visitant. Flights of these owls take place periodically at approximately four year intervals, at which time numbers appear in southern parts of the province. Such an invasion occurred during the winter of 1941-42, and before that during 1937-38. As elsewhere in 1941, many were reported in Simcoe County. A specimen secured by Dr. Brereton at Wasaga Beach on November 1, 1941, is in the writer's collection. Mr. Neil McCuaig shot one at Shanty Bay on November 13, 1941. A specimen taken during the 1937 flight at Tottenham on November 20, is in the R.O.M.Z., while another was shot at Creemore on November 25. A pure white bird, captured alive by Mr. H. Harvey at Bondhead, was seen by the writer on January 29, 1938. An individual was reported shot at Orillia by Mr. B. Studd and Mr. A. Pedwell on February 1, 1938. Another incursion, on a somewhat smaller scale, took place during the winter of 1930-31, when Snowy Owls were reported taken at Barrie in November, December and January and at Orillia in January (1931). Fleming (1913) records having "examined between November 19 and 26, 1906, several more exceptionally white birds from the city and three from Bradford, forty miles north of Toronto; these were also very white birds."

The latest date of birds lingering into the spring is April 19 (1939), when Mr. W. W. Gunn saw one perched on the ice in Collingwood harbour.

A specimen shot at Collingwood on January 30, 1941, and examined by Mr. L. H. Beamer was found to have the remains of two common house rats in its stomach.

♂ November 20, 1937, Tottenham.* ♂ November 13, 1941, Shanty Bay.*
♀ November 1, 1941, Wasaga Beach.

119. **Hawk Owl.** *Surnia ulula.*—A rare winter visitant from the north; one record. A fine mounted specimen in the collection of Mr. S. Barnes was taken by him at Collingwood in the winter of 1919.

120. **Barred Owl.** *Strix varia.*—An uncommon fall and winter visitant and a rare summer resident. A few of these owls are noted each year, and during some winters, flights of considerable proportions occur when birds from the north move into more southern sections of the province. In such invasions, many birds fall to the guns of hunters. During November and December, 1939, individuals were reported seen at Little Lake, Barrie, Big Bay Point and Bradford.

The finding of two Barred Owls near Penetanguishene by Messrs. Shortt, Snyder and Hope on June 12, 1935, lends support to the belief that this species eventually may be found breeding in the county.

♂ June 12, 1935, Penetanguishene.* ♀ November 4, 1939, Shanty Bay.
♀ December 10, 1938, Barrie. ♀ December 4, 1940, Little Lake.

121. **Great Grey Owl.** *Scotiaptex nebulosa.*—A rare fall and winter visitant. As is the habit of some species of northern owls, the Great Grey has been known to make periodic flights into the county from the north, but with these exceptions, it is of rare occurrence. The last large flight into Southern Ontario appears to have taken place during the winter of 1889-90. Cross (1890) states: "The Great Grey Owl has this year been very common in Ontario—this winter (1889-90) I have received twenty-three specimens—one of my acquaintances stationed at Barrie received twenty-six this season. They began to come into this region in November and increased in numbers up to February, after which they became very scarce again." A mounted specimen in the collection of Mr. S. Barnes was shot by him at the mouth of Batteaux Creek, Collingwood, in the winter of 1918-19. Mr. H. B. Haugh collected a specimen (now mounted) at Oro Station on February 17, 1943.

122. **Long-eared Owl.** *Asio wilsonianus.*—An uncommon spring and fall transient and a rather rare summer resident; breeds. A single bird was observed at Collingwood by Mr. S. H. Henry on May 20, 1913; and Mr. S. Barnes took a specimen there about 1920. Our only winter record is that of an individual seen by Dr. Brereton at Barrie on February 29, 1936.

At least three instances of breeding have come to our attention. On May 23, 1920, Drs. Harrington and Starr found it nesting near Bradford (Snyder, 1930). A nest containing four eggs was located by the writer on April 17, 1938, in a cedar swamp bordering the Holland River, four miles southwest of Bradford. On May 15, it contained two small young and two apparently infertile eggs. Dr. Brereton discovered a nest of three eggs, ten miles south of Barrie on May 24, 1943.

123. **Short-eared Owl.** *Asio flammeus.*—A rare spring and fall transient. Although considerable seemingly ideal breeding territory exists within the county, this species has only been recorded as a migrant. A mounted specimen in the collection of Mr. Nicol Anderson was taken by him at Little Lake about 1925. A bird shot at the mouth of Batteaux Creek, Collingwood, in 1929, by Mr. S. Barnes is in his collection. A male specimen taken on April 16, 1934, at Waubaushene by Mr. W. Hahn is in the R.O.M.Z.; and a female in the writer's collection was taken by Dr. Brereton at Wasaga Beach on October 13, 1941.

♂ April 16, 1934, Waubaushene.* ♀ October 13, 1941, Wasaga Beach.

124. **Little Boreal Owl.** *Cryptoglaux funerea.*—A rare winter visitant of irregular occurrence. Two definite records of this species are known for the county. On October 12, 1922, one was shot by Dr. Harrington at the mouth of the Nottawasaga River but unfortunately the specimen was not preserved. During the night of February 15, 1940, an individual flew against a door at the home of Mr. Nicol Anderson at Little Lake and was killed. Through the kindness of Mr. Anderson and the efforts of Dr. Brereton the specimen was later secured and is now in the writer's collection.

? February 15, 1940, Little Lake.

125. **Acadian Owl.** *Cryptoglaux acadica.*—A rare summer resident and occasional winter visitant; breeds.

This tiny owl may be much commoner as a breeding bird than is generally supposed, being probably often overlooked owing to its small size and secretive habits. Dr. Harrington reports finding a family of five young not long out of the nest at Oakview Beach about 1924. A nest of this species containing young was observed at Barrie by Dr. Brereton in 1931.

In February, 1927, Mr. Noah Cotton captured one of these owls as it sat on a verandah trellis in Elmvale. The mounted bird was later seen by the writer. One was observed in the Ovenden College grounds at Barrie by Dr. Brereton on February 3, 1940. On April 2, another, or possibly the same individual, was found dead at the same place and the specimen kindly secured for the writer by Dr. Brereton. Mr. R. A. Smith observed one in a garden at Bradford on November 18, 1940.

A mounted specimen shot at Allenwood in 1937, is in the possession of Mr. Clifford Grigg. Two specimens in the Barnes collection were taken at Collingwood about 1910.

♂ April 2, 1940, Barrie.

(*To be continued*)

TRANSACTIONS

of the

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198 COLLEGE STREET
TORONTO, CANADA

THE DRAINAGE PATTERN IN ALBERTA

By P. S. Warren

Introduction

A glance at a map of Alberta of sufficient detail to show the smaller tributary streams of the main rivers demonstrates the existence of a drainage pattern which is on the whole remarkably definite in its arrangement, but which, on close study, presents many inconsistencies which cannot be explained without some knowledge of the geological history of the area. The broad pattern is very simple. The main rivers, heading in the Rocky Mountains, follow the general slope of the land in a consequent direction. The Saskatchewan River sytem, which is responsible for the drainage of most of the southern half of Alberta, flows in an east-northeast direction which direction is normal to the front ranges of the Rockies in that area. The water is finally discharged into James Bay. In Northern Alberta, the Peace and Athabaska rivers are responsible for the drainage and they develop a more northerly trend and enter the Mackenzie River drainage system which discharges its water into the Arctic Ocean. Such a general pattern is obvious. The smaller details of the pattern, however, are not obvious. Although the consequent direction of the main streams is northeast and that of the smaller tributaries is southeast and northeast, most of the main streams, through some part of their course assume the northwest-southeast direction. The question that must be answered is, why do the smaller tributary streams assume the northwest-southeast direction and why do the main streams in some places do the same? Is it the result—firstly, of topography or, secondly, of structure in the underlying rocks, or, thirdly, of glacial interference with drainage? The present study is for the purpose of making some attempt to answer these questions.

Physiographic Control in Stream Pattern

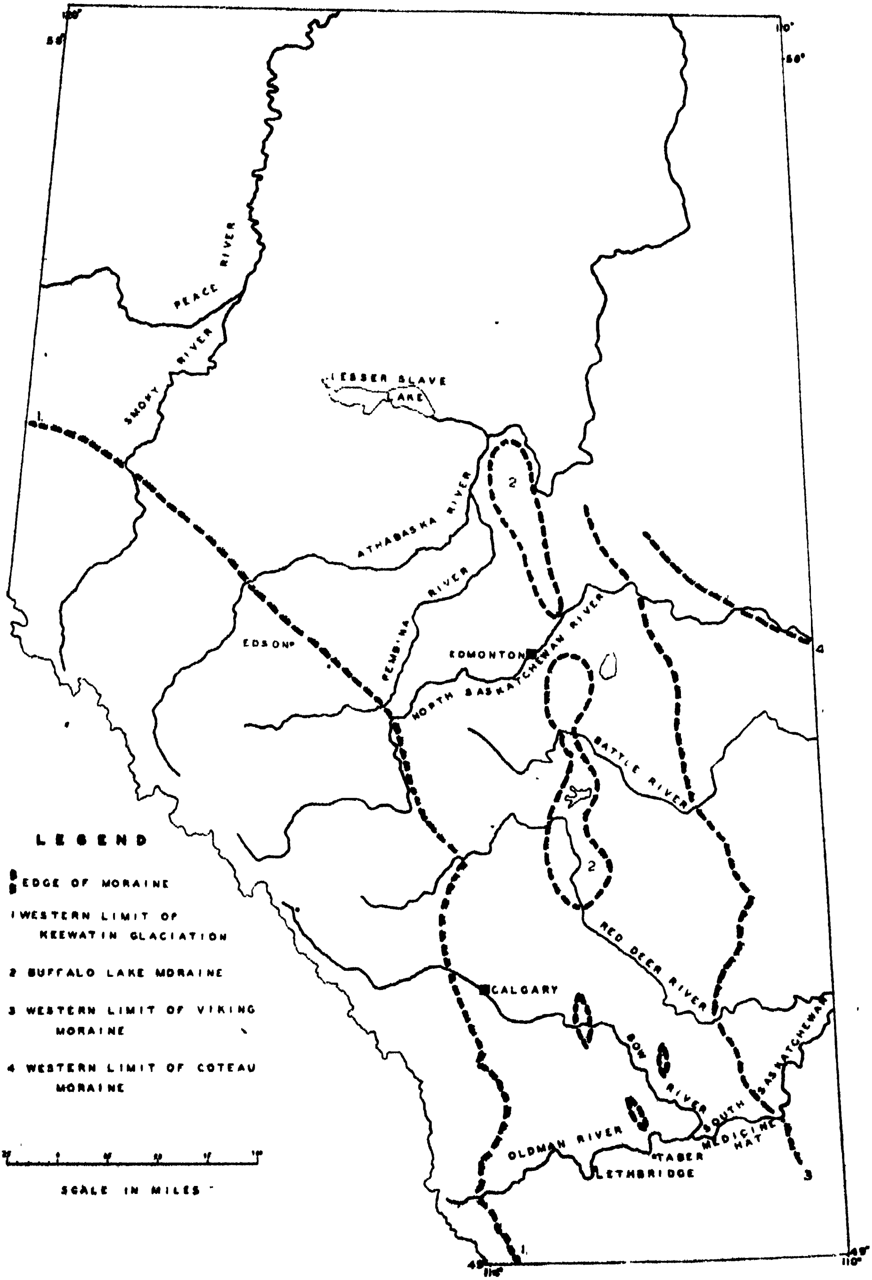
Physiography seems to play little part in this development of the stream pattern in the plains area of Alberta with the exception of determining the general consequent direction of the main streams. The plains area is remarkably featureless except for morainal hills and a very few residuals of erosion such as Cypress Hills in the south of the Province, Handhills near Red Deer River, and Swan Hills south of Lesser Slave Lake. Cypress Hills form the divide between the Saskatchewan drainage system and the Mississippi drainage system, but the divide between the Saskatchewan and the Mackenzie River drainage is quite featureless. The main rivers do not approach these residuals sufficiently closely to be affected so far as direction of flow is concerned. They do not have to change their course to pass around them. It is quite possible that the larger rivers are following pretty well in the course of the pre-glacial drainage which would naturally not be close to the large residuals which that drainage left uneroded.

In the mountains and foothills regions physiography of course plays a large part in the drainage pattern. The main streams emerge from the mountain and traverse the foothills in wide valleys with well developed subsequent tributaries. It is not this part of Alberta that presents any special problem in drainage pattern and it will not be considered further here.

STRUCTURAL CONTROL OF STREAM PATTERN

The main structural feature of Alberta is a very broad syncline or geocline which underlies most of the plains area. The west limit of the geo-syncline is limited by the foothills area whereas the east limb extends pretty well to the eastern border of the Province. The dip of the beds is very gentle and seldom exceeds fifteen feet or twenty feet a mile. The underlying rocks are Cretaceous sandstones and shales except in the centre of the geo-syncline where the Paskapoo sandstone of Palaeocene age is preserved. Most of these strata are soft and non-resistant and seldom produce erosional features.

The general strike of the strata underlying Alberta, controlled by the limbs of the geo-syncline, is in a northwest-southeast direction and is roughly parallel to the Rocky Mountains. The direction corresponds very well to the northwest-southeast drainage pattern which is assumed by most of the smaller tributary streams and by some of the main streams through some part of their course. It seems reasonable to assume, therefore, that the northwest-southeast drainage in the plains area in Alberta may be controlled by underlying rock structures just as it is in the foothills region. Results of recent studies of broad areas in Alberta rather tend to oppose such an assumption. In the first place the smaller tributary streams seldom expose the underlying rock and probably seldom cut through the mantle of glacial drift. In the second place it is found that glacial features exercise a considerable control of the drainage pattern both in the tributary



MAP No. 1.—Outline map of the southern portion of Alberta showing the main rivers and the principal glacial features.

streams and in places also in the main streams. It is best to postpone any decision relative to the structural control of stream pattern until the glacial features and their control of the stream pattern may be discussed.

GLACIAL CONTROL OF THE STREAM PATTERN

The surface of the plains of Alberta is modified by having morainal deposits some of which assume the proportion of terminal moraines of an ice sheet. Between the heaviest of these moraines are flat areas which are modified in places by lower and less extensive moraines which may be considered recessional. Some of the flat areas are the beds of post-glacial lakes but large plain areas show no sign of lake beds and are remarkable for being largely devoid of glacial drift.

The glacial history of Alberta has not been studied in detail and is far from being thoroughly understood. A complete detailed study of this interesting period of the geological history of Alberta must be undertaken before any final estimate can be made of the control the glaciers played in the drainage pattern of the area. Certain details, however, are known and there are sufficient evidences at hand to demonstrate the extent of that control.

It is proposed in the next few pages to set out very briefly our present knowledge of the glacial features of southern Alberta.

(a) *Western limit of Keewatin glaciation.*

One or more of the Keewatin ice sheets covered the larger portion of Alberta. The western limit of the advance of Keewatin ice corresponds roughly to the eastern edge of the foothills and is shown on Map No. 1. There is no pretence to accuracy of detail in drawing this line. It is the result of observations of several geologists and conclusions are not always in agreement. One would naturally suppose that the limit of Keewatin glaciation in this area would be a well defined line of morainal hills, but the opposite is the case. The line is quite featureless in most places. The second interesting feature about this line is the accuracy with which it corresponds to the outer limit of the foothills. The reason for such correspondence is not apparent. The third point of interest is the difference in elevation of the land marking the limit of Keewatin drift. In the southern part of the Province Keewatin drift is found at an elevation over 1000 feet higher than it occurs in the central part of the Province, e.g., the town of Edson, west of Edmonton. R. L. Rutherford explains this anomaly by postulating post-glacial uplift in the foothills and mountains in the southern part of the Province.[1]

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[1] Rutherford, R. L.--Some Aspects of Glaciation in Central and Southwestern Alberta. Trans. Roy. Soc. Can. Vol. 35, Sec. IV, pp. 115-124, 1941.

(b) *Buffalo Lake moraine.*

The more westerly Keewatin moraine which terminates at the beginning of the foothills has an eastern limit which has not as yet been fully mapped.[2] This moraine is defined on the east by a flat plain with very little drift, which extends eastward to the Viking moraine (Map No. 1). In the middle of this thin flat area occurs a strongly developed moraine with a north-south trend known as the Buffalo Lake moraine (Map No. 1). This moraine is very distinctive as it appears to have so little in connection with the moraines to the east or west of it.

(c) *Viking moraine.*

The Viking moraine is a very distinctive moraine of the terminal type that extends across eastern Alberta in a direction a little west of north.[3] The trend of the Viking moraine so far as it has been studied parallels the line of the furthest extension of Keewatin drift in western Alberta. The western margin of the Viking moraine is very sharply defined as it borders the flat plain area of central Alberta. The eastern margin of the Viking moraine is not very definite and has been mapped only in places. It is not shown on Map No. 1. The Viking moraine is the most conspicuous glacial feature in Alberta.

(d) *The Coteau moraine.*

The Coteau, or Altamont, moraine is well developed in Saskatchewan where it forms very conspicuous hills along the Missouri coteau, or the Coteau, as it is locally known. This moraine has a northwesterly trend and enters Alberta along north Saskatchewan River (Map No. 1). The Coteau moraine, though having a considerable effect on the drainage pattern in Saskatchewan, hardly comes within the area covered by this study.

(e) *Age of the various moraines.*

The age of the various moraines which make such a prominent feature in the plains area of Alberta will be discussed but briefly at the present time. The problem of the Pleistocene history of Alberta has not as yet been solved and much more careful mapping of moraines and minute investigation of critical areas must be undertaken before the problem is solved. The history of the principal rivers in Alberta is undoubtedly strongly linked up with the glacial history of the area and the solution of one problem will undoubtedly lead to the solution

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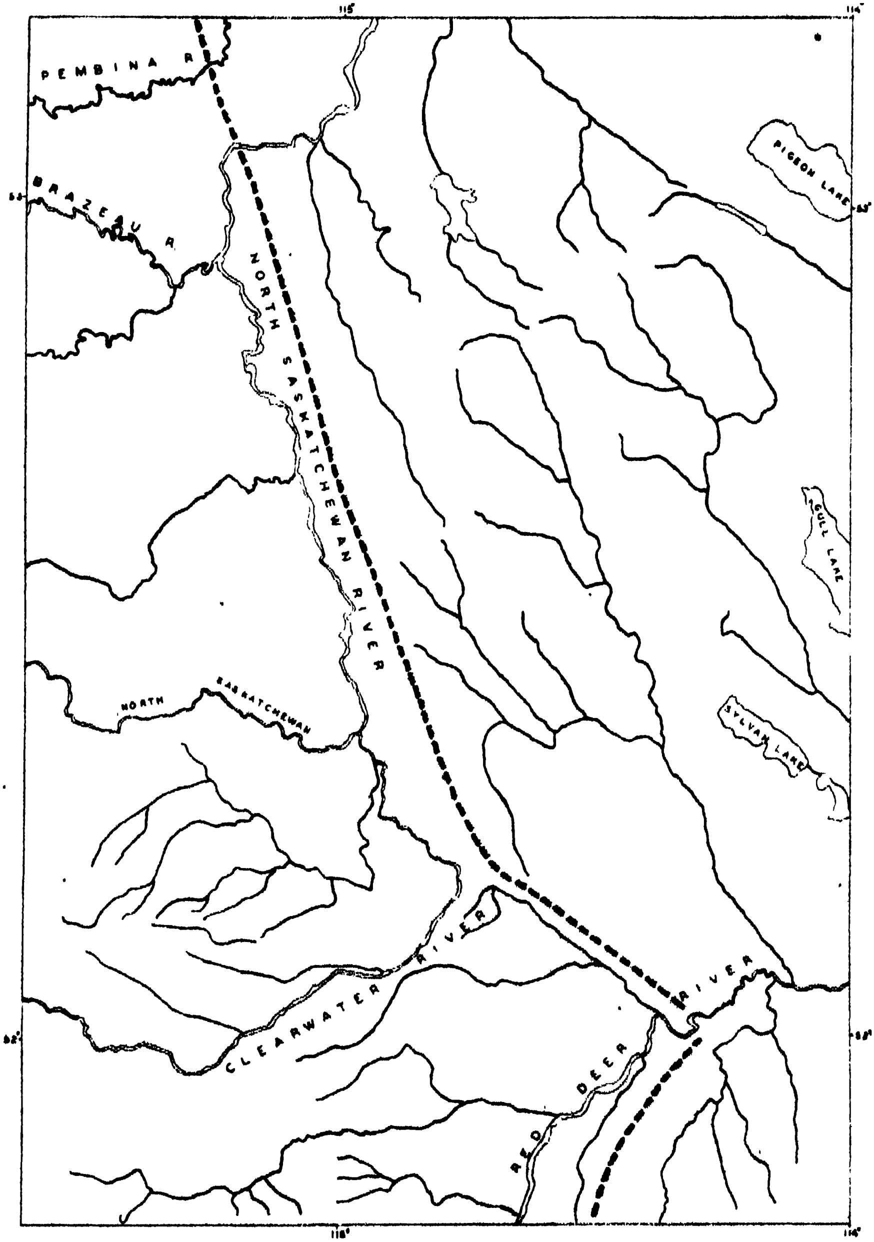
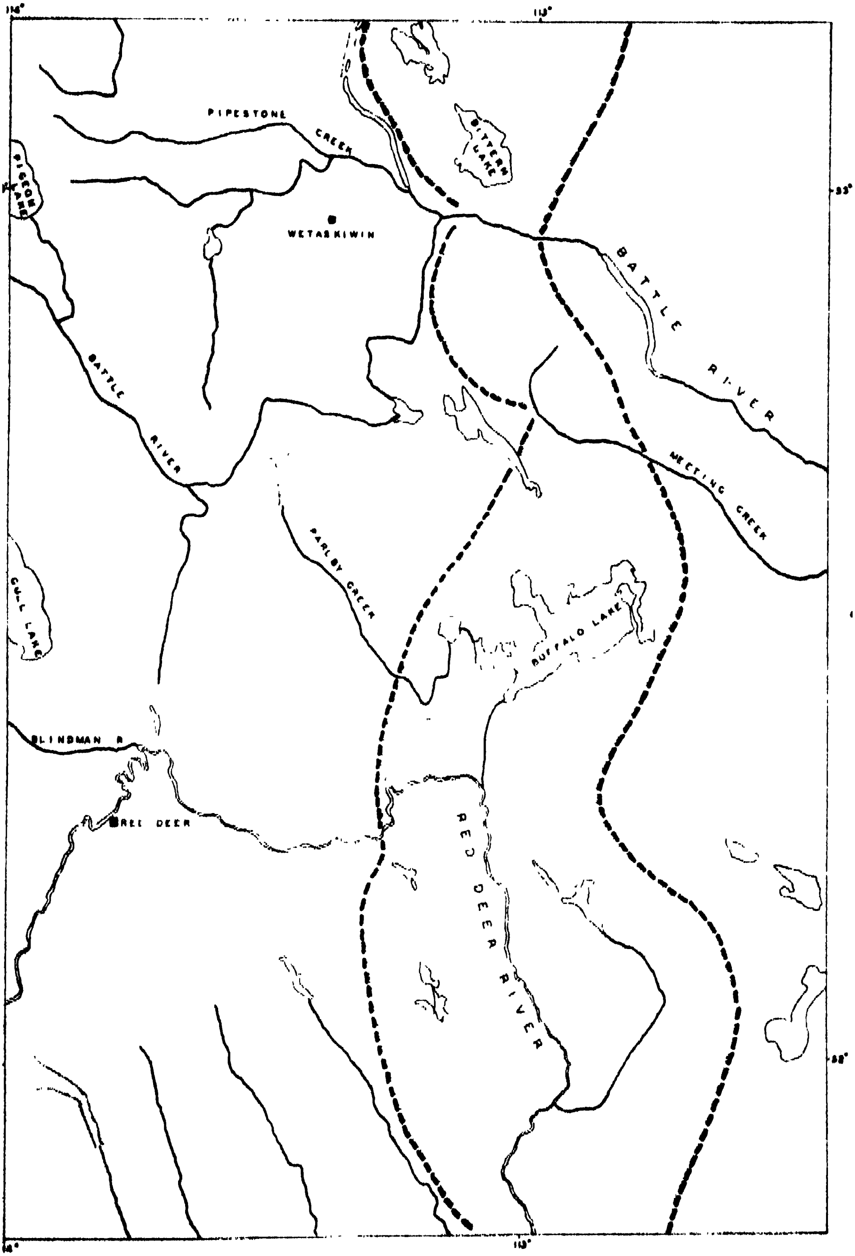
[2] Rutherford, R. L., *Op. cit.* map.

[3] Warren, P. S.—The Significance of the Viking Moraine. Trans. Roy. Can. Inst., Vol. 21, pt. 2, pp. 301-305, 1937.



MAP NO. 2.—Enlargement of portion of area shown in Map No. 1 in the vicinity of North Saskatchewan and Red Deer Rivers. Scale of enlargement X7.



MAP No. 2.—Enlargement of portion of area shown in Map No. 1 in the vicinity of Red Deer River. Scale of enlargement X7.

of the other. So far as the present investigation is concerned, it is necessary to consider only broad generalities and the age of the different moraines need not be involved. It is the writer's conviction from all the evidence available that the moraines on the western side of the province are older than the moraines on the eastern side, such as the Coteau and Viking moraines. It is quite possible that such a conviction may influence some of the conclusions reached in this paper.

EFFECT OF GLACIATION ON THE MAIN STREAMS

(a) *Changes effected by the western limit of Keewatin glaciation.*

The control exercised by glaciation on the main streams of Alberta is well shown on Map No. 1. In their course through the foothills the streams assume a general consequent direction. In passing across the line marking the western limit of Keewatin glaciation many of the streams show a marked deflection in their course. The most marked deflection is observed in North Saskatchewan River, which swings from an easterly to a northwesterly course before passing on to the plains area. This part of the Saskatchewan drainage is shown to better advantage on a larger scale on Map No. 2. A cursory examination of this map shows to what extent the front of the ice sheet effected the main drainage pattern. Melt water from both the mountain glaciers and the Keewatin ice sheet was impounded in this area for a considerable period of time as is shown by the lake beds of clay and silt up to a thickness of 50 feet, which still exist in the low area between North Saskatchewan River and Red Deer River just west of the limit of Keewatin drift. This lake, which we may call the Clearwater Glacial Lake, preserves the best evidence along the foothills area of the impounding of glacial waters in front of the Keewatin ice sheet. There is evidence in other places that such laking existed but the lake beds have not been so fully preserved. The northwest trending channel of North Saskatchewan River was probably produced by the escaping melt water in front of the Keewatin ice sheet. As the drainage re-established itself as the Keewatin ice retreated, the North Saskatchewan made use of this pre-existing channel in establishing its course.

Other streams do not show the deviation in their channels to the same extent as the North Saskatchewan. Some do not show any deviation in passing into the Keewatin drift area, such as the Oldman River. There may be other contributary causes for the deviation shown by the stream channels in passing into the Keewatin area but such causes are not at all evident. As the writer's main studies of the river channels have been in the area of North Saskatchewan and

Red Deer Rivers, where the evidence of glacial control is so well marked, he has little hesitation in attributing the change in drainage direction at the limit of Keewatin glaciation as due mainly to glacial action.

(b) *Changes effected by the Buffalo Lake moraine.*

The Buffalo Lake moraine, lying on the flat plains area of Central Alberta, has had a considerable effect on the courses of the main streams. In the north the Athabaska and its tributary, the Pembina, are forced out of their regular course and pass around the northern end of a large moraine which extends north from Saskatchewan River. The extent and character of the Buffalo Lake moraine north of the Athabaska is not known. There seems little doubt, however, that the course of the Athabaska in this area was the result of glacial action.

The course of North Saskatchewan River seems to be very little affected by the Buffalo Lake moraine. It passes through the moraine in a low area in what appears to be a wide pre-glacial channel now filled with glacial drift and glacial lake deposits.

The course of Red Deer River shows probably the greatest effect of the Buffalo Lake moraine. The river is turned completely from its northwest course and follows a southeast direction. The valley, in this part of its course, is in the nature of a canyon and much of the "badlands" occur in this area. It is believed that the valley of the Red Deer, in its southeast course, was originally formed by melt water escaping to the southeast along the front of the retreating ice sheet. This is verified to a certain extent by the valley of Battle River just north of Red Deer River which assumes the same southeasterly trend. The Battle is a small stream occupying a very wide valley in its southeasterly course. Battle River enters this wide valley as it approaches the Buffalo Lake moraine. The wide valley extends north along the western edge of the Buffalo Lake moraine nearly to North Saskatchewan River but it is not there occupied by any sizable stream. This is shown in part in Map No. 3.

Bow River assumes the same southeasterly direction as the Red Deer when it enters the Buffalo Lake morainal area. The moraine is not so pronounced in the area along the Bow and the valley of the river is not so canyon-like as that of the Red Deer. The banks, however, are sharp and exposures continuous.

Oldman River fails to show much diversion of its course as it enters the Buffalo Lake morainal area just as it failed to be diverted where it entered the Keewatin glacial area to the west.

(c) *Changes effected by the Viking moraine.*

All the main streams passing across the Viking moraine are profoundly affected. North Saskatchewan River is turned from its northeast course to an easterly course. Battle River is turned at right angles to a northeasterly course. Red Deer River swings from a southeasterly course to an easterly direction and South Saskatchewan River turns at right angles to assume a northeasterly course. There seems very little regularity in the change of direction produced by the moraine. In some instances they undoubtedly occupy pre-existing valleys formed by the run-off of melt water from the retreating ice sheet. Such valleys, not now occupied by streams, are quite common in the morainal area.

(d) *Changes effected by the Coteau moraine.*

The Coteau moraine enters Alberta about the latitude of Edmonton. Its western limit parallels North Saskatchewan River and undoubtedly is responsible for assisting in establishing a southeasterly direction for that stream. Farther to the southeast the Coteau moraine also profoundly affects the direction of South Saskatchewan River but that is outside the area being considered at the present time.

The exact reasons underlying the change in direction of flow of streams as they enter the heavy morainal areas is outside the scope of this paper. The time sequence of such changes is also a matter for further study and must be based on a fuller understanding of the glacial history of the area. It is sufficient at the present time to draw attention to the outstanding features of the drainage in relation to the heavier moraines.

EFFECT OF GLACIATION ON TRIBUTARY STREAMS

It has been shown that the general trend of the main streams across Alberta is in an easterly or northeasterly direction but that they sometimes assume a southeasterly direction through some part of their course. This southeasterly, or northwesterly, trend is much better exemplified by the streams tributary to the main rivers and it is notable that they assume this direction in areas which are fairly heavily covered with ground or recessional moraine. This is well shown in Map No. 2, where all the tributary streams in the area of Keewatin glaciation assume this general direction. In areas where ground moraine is very thin, as on the plains area immediately to the east and west of Buffalo Lake moraine, the tributary streams are much more irregular in their direction of flow. This is well shown on Map No. 3, where the tributary streams of Battle River in the vicinity of Wetaskiwin, where ground moraine is very thin, assume irregular directions. On the other hand, south and west of Red Deer River, where ground moraine is quite heavy, the southeast trend of the small streams is very much in evidence. This same general trend of tributary streams is also well developed in the area east of the Viking moraine.

It is believed that such a pattern of flow of smaller streams must be attributed to glacial control rather than to rock structures beneath the glacial drift. Rock structures may contribute to drainage pattern in local areas but the coincidence of the northwest-southeast drainage pattern with areas of well developed ground moraine must be more than accidental.

EFFECT OF PRE-GLACIAL DRAINAGE ON THE PRESENT STREAM PATTERN

Very little is known of the pre-glacial drainage channels in the drift-covered areas of Alberta. In the foothills area the main streams still occupy their pre-glacial valleys which have all been effected by tongues of glaciers extending eastward from the Cordilleran ice-sheet. This is well shown by patches of Cordilleran drift still preserved in sheltered places along the valleys of some of these streams and the U-shaped character of the valleys where they pass through the heavy limestone ridges of the front range of the Rockies. In how far the principal rivers continue in their pre-glacial channels after they pass into the area of Keewatin moraine is as yet a matter of conjecture. Some of them probably do through part of their course. The Oldman, the Bow and the Red Deer show some evidence of this. Red Deer River may be taken as an example. The Red Deer enters the Keewatin drift area with little change in direction. The valley is wide, the banks are low and the exposures intermittent along its northeasterly course. Just north of the town of Red Deer (Map No. 3) the river suddenly swings to the southeast and enters a much more confined valley with high banks and continuous exposures. This part of its valley is undoubtedly post-glacial, whereas the river in its northeasterly trend is probably occupying a pre-glacial valley or depression which it has not as yet completely cleared of drift. Varved clays and silts overlying the glacial drift are common along the banks in this part of its course, signifying that the river probably occupied a low area with considerable damming of glacial waters producing lakes. Why the Red Deer was turned out of its pre-glacial channel (if it may be so interpreted) just north of the town of Red Deer is not at all clear and is one of the problems still remaining to be solved.

North Saskatchewan River has also some points of interest. The North Saskatchewan in the vicinity of Edmonton is undoubtedly occupying a pre-glacial depression. Red rock is exposed only in the lower part of the valley where it is overlain by boulder clay and glacial lake silts and clays. Its earlier course through the Keewatin drift area is not so well known. The Saskatchewan probably enters a post-glacial valley as it swings to the southeast on entering the Viking moraine though the different character of the valley is not so striking as that of the Red Deer where it enters its post-glacial valley. If the pre-glacial valley of the Saskatchewan continued to the northeast past this point, it probably entered the Mackenzie River drainage and not the Hudson Bay drainage system.

In conclusion it should be pointed out that lack of sufficient data greatly limits our knowledge of pre-glacial physiography. Much painstaking work must be undertaken before the problem of pre-glacial drainage may be solved.

CONCLUSIONS

In this paper the writer has endeavoured to bring out the following facts:

(1) That the main streams in Alberta follow the general slope of the land.

(2) That the main streams probably occupy pre-glacial channels through some part of their course in the Keewatin drift area and undoubtedly do follow their pre-glacial channels through the foothills area.

(3) That the heavy belts of glacial moraine strongly affected in places the courses of the main streams and the courses of some of these streams were also affected on entering the Keewatin morainal area.

(4) That the drainage pattern of the smaller tributary streams in the Keewatin morainal area is controlled almost completely by morainal deposits. The effect of underlying rock structures appears to be negligible.

SOME ORDOVICIAN TRILOBITES FROM ONTARIO

By G. Winston Sinclair
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A large number of trilobites have been reported from the Middle Ordovician rocks of Ontario, most of which are also known from New York and other areas. They have been rather fully described, and new species are very rarely found. The present paper describes five species from beds of Black River and Trenton age and proposes a new subgenus of *Bathyurus*. The type specimens are in the writer's collection and have been deposited in the collections of the Geological Survey, Ottawa, where they will be available for study.

Dr. Madeleine A. Fritz has kindly assisted by loaning specimens of *Bathyurus* from the collections of the Royal Ontario Museum of Palaeontology. .

Genus **BATHYURUS** Billings 1859

Raymondites, new subgenus

Subgenotype: *Bathyurus* (*Raymondites*) *ingalli* (Raymond)

The late representatives of the genus *Bathyurus* developed a spinosity which sets them apart from their congeners. This tendency of survivors of a dying race to produce spines has been discussed by various writers, and Ruedemann has published notes on trilobites exhibiting this phenomenon, which he considers to be an atavistic character (New York State Museum Bulletin 227-228, pp. 70-78). It is sufficient for the present paper to point out that other groups besides the bathyurids show the same trend.

Raymondites may be defined as bathyurids with a strongly pustulose cephalon, and with prominent spines on the neck-ring and on the rachis of the pygidium. The spines are the prime characteristics. A few species of *Bathyurus* have pustulose surfaces, but in general they tend to be smooth. *B. acutus* Raymond bears a spine on the posterior margin of the pygidium, directed more or less horizontally: it is not considered to belong to this subgenus. I would also exclude *B. schucherti* Clarke, which is unlike *Raymondites* except in the possession of a small spine on the neck-ring.

All the specimens known are dissociated cranidia, free cheeks and pygidia. The fragile marginal rim of the cephalon is seldom preserved.

With the usual poor material most writers have been content to identify any spinose *Bathyurus* as *B. spiniger*. Hall's original figure of the type specimen is so obscure that precise comparison is impossible. Kay has recently published a figure of a well-preserved cranidium, which he identified as *B. spiniger* after comparison with Hall's type, so that we now have accurate knowledge of the two described species.

The subgenus is confined to the Black River and lower Trenton beds of northeastern North America.

Bathyurus (Raymondites) ingalli (Raymond)

Plate I, figures 9-11

Bathyurus ingalli, Raymond 1913; Geol. Surv. Canada, Museum Bull. **1**, p. 57, pl. vii, 7; 1921, Bull. **31**, p. 31, pl. ix, 3-5.

The pygidium described by Raymond in 1921 has an excellently preserved spine, but the specimen is crushed and some of the characters are not clearly seen. A pygidium from Paquette Rapids is therefore figured. It was found associated with a cranidium which lacks the spine but otherwise agrees well with Raymond's holotype.

Pygidium comparatively large, regularly rounded in outline, very convex. Rachis rather wide, strongly elevated, pustulose, with two strong rings in front of the spine, behind the spine faintly pustulose but not ringed. Spine stout and ovate in section, of unknown length, rising from obscure third and fourth rachial rings and an extremely faint fifth ring. Pleural ribs four in number, broad, smooth, grooved on the internal cast. Margin broad, smooth, concave.

Length, 14 mm.; width, 20 mm.; width of rachis, 7 mm.; length of base of spine, exfoliated, 2.5 mm.

Bathyurus (Raymondites) spiniger (Hall)

Acidaspis spiniger, Hall 1847; Pal. New York, **1**, p. 241, pl. 64, figure 5.
Bathyurus spiniger, Clarke 1899; Geol. Minn., **3**, 2, p. 723, text ff. 38-40.
Raymond 1902; Bull. Amer. Pal. **3**, pl. xix, 1-3.
Raymond and Narraway 1910; Ann. Carnegie Mus. **7**, p. 48, pl. xv, 4-6.
Foerste 1920; Denison Univ. Bull. **19**, p. 222, pl. xxii, 20.
Schrock and Raasch 1937; Amer. Midland Natur. **18**, p. 577, pl. x, 14.
Kay 1937; Geol. Soc. Amer. Bull. **48**, p. 400, pl. 9, figure.

Some of these references are to species which are clearly separable from *B. spiniger*, but such separation can best be made by those studying the actual specimens. Since Kay has put the species on a firmer footing a more critical re-study of specimens from other areas will be possible.

Bathyurus (Raymondites) bandifer new species

Plate I, figures 12-13

Description: Cranidium of medium size for the genus; glabella convex, with numerous sharp pustules; border wide, smooth, flat; eye lobes rather large, situated close to the neck-ring; neck-ring flat, with three or four small pustules, bearing two short diverging spines on the posterior edge.

Length, including spines, 16.5 mm.; width of cranidium near the front, about 8.5 mm.

An associated pygidium is small, depressed, with a prominent rachis. Rachis with two rings in front of the spine, almost smooth posteriorly, with a few faint pustules. The spine rises from very obscure third and fourth rings. Pleura with ill-defined smooth ribs; margin wide and flat.

Length, 8 mm.; width estimated to be 7 mm.

Occurrence: Black River limestone, 7 miles northwest of Cobden, Ontario, an old quarry along the highway to Pembroke.

Remarks: The diverging spines on the neck-ring are unique. The pygidium is smaller and narrower than those from Ottawa which have been identified as *B.* (*R.*) *spiniger.*

Genus **ACHATELLA** Delo 1935

Achatella billingsi new species

Plate I, figures 1-2

Description: Cephalon semicircular in outline, of low convexity; glabella depressed and almost flat posteriorly, descending in a very gradual curve to the anterior margin; cheeks elevated, sloping abruptly down in front of the eyes and to the lateral margins, more gently towards the rear; border narrow, flat, not set off sharply from the rest of the cranidium; eyes elevated, conical, situated about one-third the distance from the dorsal furrow to the margin, opposite the second glabellar furrows; lenses arranged in diagonal series, about six can be counted at any one place in a vertical direction. Frontal lobe of the glabella broad, the first furrows directed a little backwards, the second a little forwards, and the third are transverse. Surface of the glabella with low scattered tubercles; cheeks smooth. Genal spines divergent.

Thorax with a wide, slightly convex, rachis; pleura smooth and grooved. Pygidium not known.

Length of cephalon, 9 mm.; width to the base of the genal spines, 18 mm.; height of eye, 2 mm.; width of rachis of first thoracic segment, 5.5 mm.

Occurrence: Middle Trenton at Lakefield, Ontario.

Remarks: The species of *Achatella* are all very similar in general aspect, and the forms are discriminated on rather fine details. Compared to *A. katharina* (Bradley 1930) the present species is more nearly straight in front, has a lower eye and more elevated cheek. It is wider than *A. carleyi* (Meek 1872). It differs from *A. achates* (Billings 1860) Okulitch in lacking the wide marginal border, being narrower, and having more elevated cheeks.

Genus **OTARION** Zenker 1933

Otarion wilsonae new species

Plate I, figures 3-4

Description: Specimen small; cephalon crescentic in outline, protruding a little in front of the glabella, convex in both lateral and longitudinal outlines, surrounded by a flat border; glabella convex, elevated, rounded in front; dorsal furrows parallel anteriorly, diverging at the basal lobes; basal lobes clearly outlined in front by furrows which are almost straight, directed obliquely backwards, becoming obsolete before reaching the neck furrow; first glabellar furrows faint, reaching not quite one-third across the glabella. Eyes large and prominent. Neck-ring wide and prominent. Facial sutures rising about half-way between the dorsal furrow and the genal angle, running sharply inward to the anterior side of the neck-ring, then crossing the eye sigmoidally and continuing the curve almost to touch the glabella at the level of the first glabellar furrow, then outwards, cutting the anterior margin at a point directly in front of the eye. Entire surface covered with very minute obscure granules.

Thorax with nine segments; rachis prominent and convex. Pygidium not known.

Width of cephalon lacking the genal angles, 6.5 mm.; length of same 4.8 mm.

Occurrence: In the lower Trenton at Eganville, Ontario. The locality is a small old quarry just south of the Lutheran church.

Remarks: Some eight species of this genus have been described from the Ordovician of North America as *Cyphaspis*, but none of them seems to be very similar to the present species. *O. matutina* (Ruedemann 1901), *O. trentonensis* (Weller 1903) and *O. minima* (Cooper 1930) have the basal lobes isolated; *O. borealis* (Twenhofel 1928) and *O. globosa* (Bradley 1930) are much smaller and show other differences; *O. slocomi* (Raymond 1925) has a narrow pustulate neck-ring, and *O. anticostiensis* (Twenhofel 1928) has a tuberculated surface.

The specific name is for Miss Alice E. Wilson of the Geological Survey of Canada.

Genus **HEMIARGES** Gurich 1901

Hemiarges aeolus new species

Plate I, figures 5-7

Description: Cranidium subtriangular in outline as seen from above, bent sharply down in front, so that as much of the glabellar surface is vertical as horizontal; border around the anterior margin narrow and flat. The median pair of furrows turn outwards sharply behind the first lateral lobes. These are scarcely distinguished from the second lateral lobes posteriorly, but are separated by a shallow furrow on the anterior slope. Posterior side lobes marked off by very faint furrows. Neck-ring separated from the glabella by a deep furrow, strongly elevated, especially medially where it bears three strong tubercles, of which the middle one is longest. Entire surface covered with prominent tubercles of various sizes which are more uniform and closer together in front; much the largest are a pair on the highest part of the glabella and one each on the highest points of the lateral lobes.

Length horizontally, from the neck-ring to the front, 8 mm.; height, 7.5 mm.; width, 14 mm.

Occurrence: In the middle Trenton at Lakefield, Ontario.

Remarks: Most *Hemiarges* from Ontario have been identified as *H. paulianus* (Clarke 1899), which is only one-third as large as the present species, as is *H. leviculus* Bradley 1930. *H. bartoni* Raymond 1925 is smaller and narrower than *H. aeolus*. *H. tuberculatus* (Weller 1903) is one-half the size. There are other differences in proportions which will be more readily apparent from a comparison of the figures.

Genus **CYBELOIDES** Slocom 1913

Cybeloides plana new species

Plate I, figure 8

Description: Holotype a cephalon of medium size, subquadrate in outline, of low convexity; glabella rectangular, bearing rather coarse pustules; lateral lobes cut off from the rest of the glabella by a wide furrow; eyes distant from the glabella; genal spines flaring.

Thorax with a rather narrow rachis, a little convex; the pleura flat and grooved.

Width of cephalon to base of the genal spines, about 18 mm.; length of glabella, 6 mm.

Occurrence: Middle Trenton, Finch, Ontario.

Remarks: This genus is so rare that the present specimen is described in spite of its imperfections. It is well enough preserved to allow identification of other specimens with it. *C. plana* is twice the size of *C. winchelli* (Clarke 1899), of which the glabella is unknown. *C. ella* (Narraway and Raymond 1906) is much smaller, and the grooves separating the lateral lobes from the glabella are discontinuous. The other described species are known only from pygidia.

Vogdes doubted the necessity for this genus, but it seems to be useful and has been generally adopted, although in Britain it is usually treated as a subgenus of *Cybele*.

EXPLANATION OF PLATE I

Except where otherwise stated, figures are natural size

Figures 1 and 2.—*Achatella billingsi*, new species. 1, side view of the cranidium. 2, dorsal view of same, × 2.2. Middle Trenton, Lakefield, Ontario.

Figures 3 and 4.—*Otarion wilsonae*, new species. 3, front view of the enrolled specimen, to show the convex glabella and prominent eyes, ×2. 4, dorsal view of same, ×4. Lower Trenton, Eganville, Ontario.

Figures 5 to 7.—*Hemiarges aeolus*, new species. 5, posterior view, showing the nuchal spines and the pustules on the lateral lobes. 6, dorsal view, ×2.2. 7, lateral view, showing the prominent neck-ring. Middle Trenton, Lakefield, Ontario.

Figure 8.—*Cybeloides plana*, new species. Middle Trenton, Finch, Ontario.

Figures 9 to 11.—*Bathyurus* (*Raymondites*) *ingalli* (Raymond). 9 and 10, a pygidium from Paquette Rapids. 11, the holotype, Geological Survey Collections, No. 4318. Lower Trenton, Kirkfield, Ontario.

Figures 12 and 13.—*Bathyurus* (*Raymondites*) *bandifer*, new species. 12, the type cranidium, seen from the interior. 13, dorsal view of the associated pygidium, both ×2. Black River, near Cobden, Ontario.

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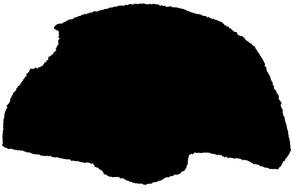
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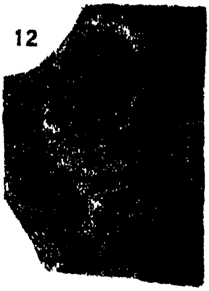
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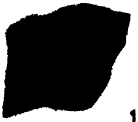
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SINCLAIR: SOME ORDOVICIAN TRILOBITES FROM ONTARIO

CONCERNING SOME CHANGES IN THE AORTIC ARCHES AND THEIR DERIVATIVES—WITH REFERENCE TO THEIR ULTIMATE FATE IN BIRDS[1]

By FRED H. GLENNY[2]

In several recent studies (7-22) the writer has presented the basic arterial arrangement-patterns of several species, families, and orders of birds, as well as some of the more important pattern-variations in so far as this was possible within the limitations of time and numbers of species and specimens available for study.

Such studies at first or in rather isolated instances may appear to be of little importance, but when a larger series of such studies is available for more critical examination one may begin to grasp some thread of significant trends in avian relationships.

To understand thoroughly reptilio-avian relationships, comparable studies as well as further paleontological studies should be carried out on the reptiles. Once these studies have been completed, then perhaps it will become possible to establish more clearly the lines of reptilian and avian evolution, with more feasible interpretations with regard to their probable "interrelationships."

Lowe (26, 27) and Glenny (19-22) have previously indicated the possibilities of a polyphyletic (reptilian) origin of birds and have indicated further that the present day forms appear to show different levels in evolution. The Tinamous, for example, may have had a common primitive origin with the Gallinaceous birds; the ancestral forms of the Galliformes, however, probably diverged from the main line (the common root or stem of several present day orders of related birds) at an earlier time—undergoing rapid differentiation in several directions—while the tinamous probably diverged later (higher on the stem) and evolved more slowly, thereby retaining many of the primitive reptilio-avian characters (24).

An almost avian arterial arrangement is found in the reptile *Emys* (Figure 1) (3). This may be considered as an indication of a primitive relationship with certain "bicarotidinae normales" birds (1, 6) whereas it might also be considered as a case of parallel development in reptiles. A larger series of similar studies might better establish the arterial arrangement-patterns in reptiles and, as a result, give a better understanding of this particular problem of relationships.

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[1] Contribution from the Department of Zoology, University of Toronto, Toronto, Ontario, Canada.

[2] Formerly Assistant, Department of Zoology, University of Toronto; now on active service with the United States Army.

Many and various changes in the aortic arches and their derivatives occur in the various families and orders of birds. Several of these have been mentioned by Hafferl (3), Lillie (25), and Glenny (7, 8, 9, 12, 16, 19, 20). Many of these changes are well known, whereas others are but little known or are quite variable in different groups (Orders) of birds.

Tandel (3) sums up the changes occurring in the subclavian arteries of birds as follows, "*Auch bei Vögeln ist, wie bei Cheloniern und Krokodilen, die Arteria subclavia des erwachsenen Tieres kein einheitliches Gefäss. Es wird wie bei den meisten Wirbeltieren eine primitive Arterie für den Extremitätenstummel als Ast der dorsalen Aorta angelegt, doch erhält diese später eine neue Wurzel aus dem ventralen Abschnitte des Karotidenbogens, während die erste Wurzel zugrunde geht.*" To this Hafferl (3) adds the note, "*. . . Bei den Vögeln ist die Arteria subclavia auch nicht mehr das primar beim Embryo angelegte Gefäss, sondern sie hat sich an den ventralen Teil des dritten Aortenbogens angeschlossen, so dass beim erwachsenen Tier ein gemeinsamer Trunkus mit der Arteria carotis besteht, Arteria anonyma. Die Subklavia entlasst die Arteria mammaria interna und Aste für den Schultergürtel und setzt sich dann in die Arteria axillaris fort.*" (Figure 2.) The adult vessel, as the present writer has shown many times before, arises from the innominate artery at the point of origin of the common carotid artery, but as has been shown above is a secondary vessel developing after the primary subclavian of the earlier embryo.

In discussing the vertebral arteries, Hafferl (3) says, "*Schliesslich ist noch über die A. vertebralis zu berichten, deren Ursprung aus der A. carotis schon erwähnt wurde. Sie zieht schräg aufwärts und spaltet sich an XII. Wirbel in einen aufsteigenden Ast, A. vertebralis ascendens s. cervicalis, und einen absteigenden Ast, A. vertebralis descendens s. thoracica. Letzteres Gefäss ist das schwächere, es zieht durch die Querfortsatzlöcher bis zum XVIII. Segment abwärts und kann aus den Segmentalgefässen eine zweite und dritte Wurzel erhalten. Die vertebralis cervicalis zieht durch alle Foramina transversaria des Halses und betritt als schwaches Gefäss das Cavum cranii, nachdem Äste an die Wirbel, an die Muskulatur und das Rückenmark und ein starker Verbindungsast zur A. occipitalis abgegeben worden sind. Das eigentümliche Verhalten der A. vertebralis lässt sich aus der Entwicklungsgeschichte erklären. Die A. vertebralis entsteht wie bei den Säugern aus Längsanastomosen, welche die Segmental-*

gefässe verbinden. Ursprünglich erhält sie das Blut hauptsächlich aus der A. subclavia primitiva. Auch wenn die A. subclavia schon ihre sekundäre Wurzel aus dem Aortenbogen bekommen hat, bleibt der Stamm der A. subclavia primitiva als Wurzel für die A. vertebralis thoracica erhalten. Der kraniale Teil der A. vertebralis erhält Anschluss an ein Gefäss (R.c.), das neue aus der A. carotis entsteht. Dieses Gefäss dürfte aus der mit der V. jugularis verlaufenden Hautarterie entstanden sein." As the present writer has shown in several previous papers (10, 11, 12, and 15-122) the cervical portion of the vertebrals arises variously from the common carotids, from the superficial cervicals, or from the internal carotid (trunk) arteries.

According to Lillie (25), *"The 1st and 2nd arches disappear . . ., and the anterior prolongation of the dorsal aortae in front of the 3rd arch constitutes the internal carotid; the ventral ends of the 1st and 2nd arches form the external carotid. · The 3rd arch on each side persists as the proximal portion of the internal carotids; and the dorsal aorta ruptures on each side between the dorsal ends of the 3rd and 4th arches. The 4th arch and the root of the dorsal aorta disappear on the left side but remain on the right as the permanent arch of the aorta."* This is incorrect, as I have shown in more recent studies (12, 20), in that the left radix aortae generally remains as the ligamentum aortae. Lillie states further, *'On the 3rd and 4th days of incubation the 1st and 2nd aortic arches disappear. The lower ends of these arches then appear as a branch from the base of the 3rd arch on each side, extending into the mandible and forming the external carotid artery. The dorsal aorta in front of the 3rd arch constitutes the beginning of the internal carotid."* Hertwig (23) states, "*. . . Die Carotis externa entspringt in der Verlängerung des Truncus arteriosus aus dem Anfang des ersten Schlundbogengefässes und wendet sich zur Ober- und Unterkiefergegend. Die Carotis interna entsteht weiter dorsalwärts dort, wo die Umbiegung in die Aortenwurzeln erfolgt, und leitet das Blut zum embryonalen Gehirn und dem sich entwickelnden Augapfel (Arteria ophthalmica). . . .*" Thus we see that with the obliteration of the 1st and 2nd pairs of aortic arches, the internal and external carotids anastomose with the anterior rami of the dorsal and ventral radices aortae (Figure 4).

Lillie also pointed out that the internal and external carotids come to lie close to each other (Figures 3-9) and with the subsequent elongation of the cervical region, the anterior portions of these vessels anastomose; the posterior part of the internal carotids migrate ventrally and come to lie in a ventro-median position. Whereas Lillie considered the posterior portion of the external carotid (ventral radices aortae) to disappear after this anastomosis (he does not state definitely what

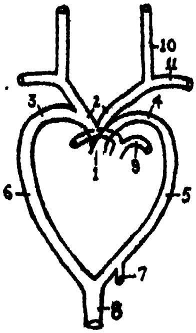

FIG. 1

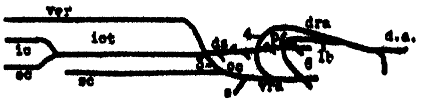

FIG. 5

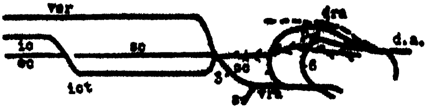

FIG. 6

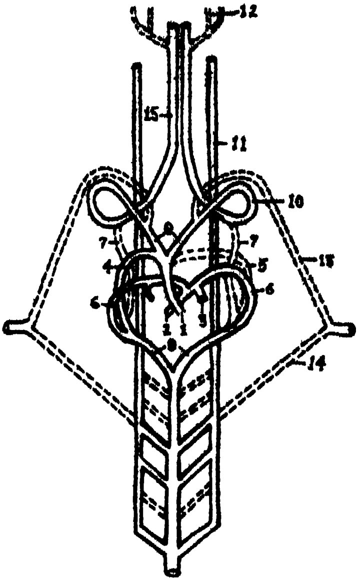

FIG. 2

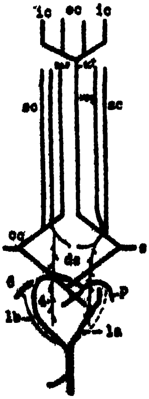

FIG. 7

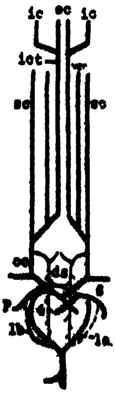

FIG. 8

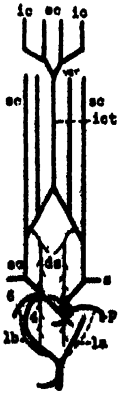

FIG. 9

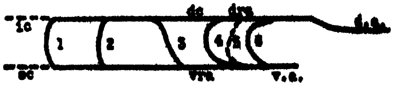

FIG. 3

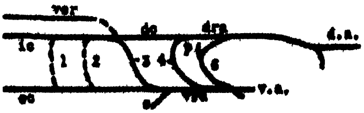

FIG. 4

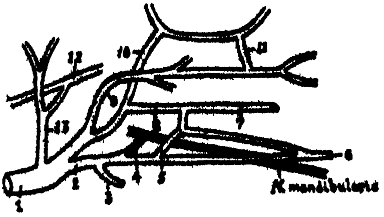

FIG. 10

becomes of the external trunk), the present writer has remarked, as has Ottley (28), upon the similarity between the paired superficial cervical arteries of birds and the external carotid of mammals. That the superficial cervical arteries are functionally modified vessels derived from the embryonic external carotid (trunk) arteries or at least from the anterior portion of the ventral radices aortae can best be seen in the late embryonic stages of the Canada Goose (20). It is entirely probable that in most instances the cephalic connection is lost through the migration of these vessels accompanied by the exceptional elongation of the avian neck, but the different parts of these embryonic vessels are not completely lost during these various transformations with the accompanying anastomoses. Other evidences, both direct and indirect,

EXPLANATION OF FIGURES

WITH A KEY TO THE FIGURES

FIGURE 1.—Diagram of the aortic arches and their main branches in *Emys*. (After Hafferl.) Ventral view.

Key: 1, aortic root; 2, innominate arteries; 3, right systemic arch; 4, left systemic arch; 5, left radix aortae; 6, right radix aortae; 7, coeliac artery; 8, dorsal aorta; 9, pulmonary artery; 10, common carotid artery; 11, subclavian artery.

FIGURE 2.—Diagram of the aortic arches and other vessels of *Gallus* (embryonic stage). (After Krassing.) Ventral view.

Key: 1, aortic root; 2, pulmonary root; 3, pulmonary artery; 4, right systemic arch; 5, left systemic arch; 6, pulmonary arch (ductus botalli); 7, ductus caroticus; 8, innominate arteries; 9, radices aortae; 10, carotid arch; 11, vertebral artery; 12, a. cutanea colli; 13, a. subclavia secundaria; 14, a. subclavia primitiva; 15, a. carotis interna.

FIGURE 3.—Diagram of aortic arches in an early avian embryo. Lateral view.

FIGURE 4.—Diagram of arteries in an early avian embryo, after the obliteration of the 1st and 2nd aortic arches. Lateral view.

FIGURE 5.—Diagram of arteries in the avian embryo, showing the anastomosis of the internal and external carotid arteries, and the functional modification of the ductus caroticus. Lateral view.

FIGURE 6.—Diagram of the adult arteries in the neck and thorax of several birds, after the ventral migration of the internal carotid (trunk) artery. Lateral view.

FIGURE 7.—Diagram of the arterial arrangement-pattern of the Fringillidae. Ventral view.

FIGURE 8.—Diagram of the arterial arrangement-pattern of several "aves bicarotidinae normales." Ventral view.

FIGURE 9.—Diagram of the arterial arrangement-pattern of several" aves bicarotidinae abnormales." Ventral view.

FIGURE 10.—Diagram of the arteries of the head of *Anser domesticus*. Lateral view.

Key: 1, carotis interna; 2, carotis externa; 3, lingualis; 4, facialis; 5, maxillaris interna. 6, alveolus interior; 7, infra orbitalis; 8, spheno-maxillaris; 9, ophthalmica externa; 10, carotis dorsalis; 11, ophthalmica; 12, vertebralis; 13, occipitalis.

in embryonic, immature and juvenile, as well as in many mature or adult forms indicate that the ventral radices aortae do remain as the functionally modified superficial cervical arteries of the adult—the right vessel serving as an ascending oesophageal artery in most of the forms referred to as "aves bicarotidinae normales" (6) (Figure 8).

As a result of the anastomosis between the internal and external carotid arteries (anterior rami), the internal carotid (trunk) arteries carry the major blood supply from the heart to the head, while the cervical blood supply is furnished by the vertebral and superficial cervical arteries. The vertebral arteries anastomose anteriorly with branches of the internal carotid arteries of the head (Figure 10), thereby further supplying the cephalic region with the necessary blood and obviating the chance loss of this large supply of blood through reduction in size of the internal carotid (trunk) arteries or in the further sinistral-dextral anastomosis of these vessels as seen in Phoenicopterus (1, 6) and certain other Ciconiiformes (13), the Kiwi (10), Cassowary (11), Rhea (12), Passeriformes (15), Piciformes (16), Trogoniformes (18), certain of the Coraciiformes (19), Cypseli and Trochili (27), as well as many others noted by Garrod (6).

In the Passeriformes, Piciformes, certain Coraciiformes, Trogoniformes, as well as several other families and orders of birds, the left internal carotid (trunk) alone enters the hypapophysial canal to supply the head with blood (Figure 7). The right vessel becomes functionally modified and comes to serve as the primary ascending oesophageal artery (19). This change results from a further anastomosis of the cephalic ends of the internal carotid (trunk) arteries. The birds in question are the "aves laevo-carotidinae," in which the anterior portion of the right internal carotid (trunk) anastomoses with the left internal carotid (trunk), the posterior portion of the right vessel does not, therefore, come to lie within the hypapophysial canal, but remains in its normal position along the neck and receives branches from the oesophagus, lymph glands, musculature, and connective tissues of the neck. Its primary function, however, is that of supplying the oesophagus with adequate blood.

A different modification resulting from anastomosis is seen in certain members of the Ciconiiformes (6, 13) in which there is a complete anastomosis of the left and right internal carotid (trunk) arteries near the base of the neck at about the point where the carotid (trunk) enters the hypapophysial canal. In these "aves bicarotidinae abnormales" species, the right superficial cervical artery comes to serve as the ascending oesophageal artery.

The ductus caroticus, which has been considered by most workers to disappear completely, becomes functionally modified as a result of its anastomosis with several smaller vessels which form *in situ* and supply the bronchi, lungs, oesophagus, syrinx and trachea. This new vessel is referred to as the ductus shawi (8). In individual specimens (in some cases for the species) there is a tendency to retain the ductus caroticus as a patent ductus (2, 4, 8, 16). The short ductus visscheri (8) sends branches to the oesophagus and trachea before anastomosing with the ductus shawi (as is the case in general) or separately with the common carotid artery in a few instances. After the ductus caroticus loses its connection to the systemic arches, the blood must traverse the remnant of the 3rd aortic or carotid arch (part of the common carotid artery of the adult bird) before it enters the functionally modified vessel (ductus shawi).

The left systemic (4th aortic) arch disappears and the left radix aortae anastomoses with the left pulmonary arch medial to the left ductus botalli. Shortly after this anastomosis (12, 20), the left ductus botalli begins to atrophy (the time for complete atrophy varies among different groups of birds) until it completely disappears. Shortly before hatching both the left radix aortae and the right ductus botalli undergo degeneration until they remain as ligamentous vestiges of their respective embryonic vessels. In some species—particularly among the Passeriformes—they disappear almost entirely and may fuse with the surrounding fascia. For the most part, however, they are found to persist throughout life, although there is considerable atrophy of these structures among the immature or juvenile forms.

Finally, we should note in passing that the pulmonary artery is a vessel which results from the anastomosis of the proximal portion of the pulmonary (6th aortic) arch and the embryonic pulmonary artery which appears to form *in situ* and fuses with the 6th arch during the very early incubation period. The pulmonary arches, therefore, become functionally modified vessels to serve their special purpose in the adult bird.

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THE BIRDS OF SIMCOE COUNTY, ONTARIO

By O. E. Devitt

Part Two*

126. **Whip-poor-will.** *Antrostomus vociferus.*—A fairly common spring and fall transient; a summer resident in the northern half of the county; breeds. The persistent calls of the Whip-poor-will soon announce its arrival in early May. Formerly common as a summer resident throughout the county, this species has become rare or absent in the region south of Barrie during the past thirty years. The destruction of favourable nesting habitat has no doubt been the chief factor in this decrease. It is still fairly common in the townships bordering on the Severn River and Georgian Bay.

Starr (1923) reported finding a set of two eggs in the Georgian Bay district on June 12, 1923. Baillie and Harrington (1937) have recorded it nesting at Wasaga Beach on July 4, 1922; and a nest with two young about a week old was found there by the writer on June 18, 1941. Mr. H. P. Bingham collected a set of two eggs at Barrie on May 26, 1933, and another on May 30, 1938.

The southward movement takes place during September. Our latest autumn record is that of a specimen shot at Wasaga Beach by Mr. J. L. Baillie on October 1, 1927.

Average date of spring arrival (6 years), May 11 (Barrie); earliest, May 5, 1940 (Barrie).

♀ June 18, 1941, Wasaga Beach.
Juv. ♀ June 18, 1941, Wasaga Beach.
Juv. ♂ June 18, 1941, Wasaga Beach.

127. **Nighthawk.** *Chordeiles minor.*—A common spring and fall transient and summer resident; breeds. This well-known species, which usually arrives from the south during the latter half of May, is often seen performing spectacular flights over our towns and villages.

Well distributed in summer throughout the county, the Nighthawk frequently lays its two eggs on the flat gravel roof of some building. Sets of eggs found by Dr. Harrington on June 8, 1921, at Collingwood and by Mr. H. B. Haugh at Barrie on July 15, 1918 (in R.O.M.Z.), have been recorded by Baillie and Harrington (1937). Mr. H. P. Bingham found a set of two eggs on the roof of a store in Barrie on June 1, 1937. Mr. D. Butler reported locating a set of eggs in a sandy pasture in Innisfil township on June 24, 1936.

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The main fall flights take place in late August and early September. Ten or more birds were observed over Wasaga Beach on August 16, 1936. On September 11, 1938, 16 were counted swirling in hawk-like fashion in a southerly direction over Holland River.

A specimen taken by Dr. Walker at the east branch of the Severn River on July 20, 1887, is in the R.O.M.Z.

Average date of spring arrival (10 years), May 22 (Collingwood); earliest, May 13, 1916 (Collingwood).

♂ July 20, 1887, Severn River, East Branch.* ♂ July 1, 1937, Wasaga Beach.

128. **Chimney Swift.** *Chaetura pelagica.*—A common to abundant spring and fall transient; a fairly common summer resident; breeds. The Chimney Swift arrives early in May, and during the migratory movement great concentrations of birds sometimes occur. At this time large chimneys or towers are used as roosting sites and numbers of swifts may be seen circling about such places preparatory to going to roost. A flock of between 200 and 300 birds was observed flying about the Catholic church in Barrie by Mr. S. H. Henry on May 18, 1917; and Dr. Brereton noted over 100 birds at Little Lake on May 16, 1939.

In summer the species is well distributed throughout the county. It has even become established on some of the larger islands, such as Giant's Tomb, where it was encountered on June 10, 1937. Mr. A. D. Henderson collected a set of four eggs from the chimney of an old log house near Barrie on June 23, 1894. A nest with three eggs was found by Dr. Harrington at Wasaga Beach on July 4, 1914 (MS). A set of four eggs in the Bingham collection was taken at Barrie on June 29, 1915. A pair nests regularly each year in a chimney at the farm of Mr. John Sutherland near Bradford.

The southward movement is underway towards the end of August, and by mid-September all but a few stragglers have departed. An individual seen at Holland River on September 15, 1940, is our latest autumn record.

A Chimney Swift banded at Nashville, Tennessee, by Mrs. F. C. Laskey on September 13, 1941, was found dead at Tollendal near Barrie on July 1, 1942, by Mr. John Sheppard.

Average date of spring arrival (8 years), May 11 (Barrie); earliest, May 4, 1938 (Barrie).

♂ July 8, 1930, Little Lake.*

129. **Ruby-throated Hummingbird.** *Archilochus colubris.*—An uncommon spring and fairly common fall transient; regularly distributed as a breeding bird in summer but nowhere very common. This tiny feathered jewel of the bird world is well known for its habit of visiting gardens in search of flowering plants. Head (1829) mentions having observed it at Kempenfelt Bay as early as June 2, [1815], and remarks on its resemblance to a bee.

A set of two eggs (nest in R.O.M.Z.) found on June 19, 1921, at Wasaga Beach has been recorded by Baillie and Harrington (1937). Mr. D. S. Miller found a nest with two eggs, 20 feet up in a birch at Oro Station on July 1, 1937. At Stayner a nest was found by Mr. J. McCague in an ash tree in his garden on July 10, 1937. The following year presumably the same pair returned to the identical tree and built a second nest. Other nests have been seen at Dalston in 1936 and at Allandale in 1940. Mr. H. P. Bingham informs me that he has found this species nesting in the following trees: cedar, spruce, beech, maple, apple and elm. What was evidently a mated pair was observed on Giant's Tomb Island on June 11, 1937. A specimen found dead by Dr. Brereton in May, 1936, was mounted and is now in Ovenden College, Barrie.

The southward movement takes place during August and early September. It has been observed at Barrie as late as September 21 (1942).

Average date of spring arrival (3 years), May 17 (Barrie); earliest, May 8, 1938 (Barrie).

♀ July 25, 1887, Orillia.* Imm. ♂ September 1, 1941, Holland River, Bradford.

130. **Belted Kingfisher.** *Megaceryle alcyon.*—A common spring and fall transient and summer resident; breeds. The characteristic rattle of the Kingfisher is a familiar sound along most of our waterways. Head (1829) mentions having shot one at Kempenfelt Bay on April 18, [1815]. Thurston and others (1892) reported securing one at Holland River on August 15, 1890.

This species nests regularly along the shores of lakes and rivers where suitable conditions prevail. Nest building is underway as early as May 12 (1940), on which date a completed though empty tunnel was found in a gravel bank at Little Lake. On May 26, this nest contained six eggs. A set of seven eggs was taken at Crownhill by Mr. H. P. Bingham, May 18, 1939. Young ready to leave the nest were noted on July 9, 1939, on the ninth concession of Innisfil township by Mr. G. Lambert. Its nesting at Wasaga Beach in 1913 and 1929 has been recorded by

Baillie and Harrington (1937). Along the Severn River, where rocky shores preclude suitable nesting sites, Kingfishers utilize sandy banks at considerable distances from water.

The fall migration takes place during September and early October, and by the middle of the latter month only a few remain. An individual noted at Minet's Point by Dr. Brereton on December 11, 1943, establishes a late occurrence date for this species.

Average date of spring arrival (10 years), April 21 (Collingwood); earliest, April 11, 1941 (Barrie).

? September 6, 1887, Orillia.*
? September 20, 1887, Orillia.*
♀ April 29, 1888, Orillia.*
♂ July 22, 1930, Little Lake.*
♀ September 23, 1934, Wasaga Beach.
♂ April 28, 1935, Holland River, Bradford.

131. **Yellow-shafted Flicker.** *Colaptes auratus.*—A common spring and fall transient and summer resident; breeds.

Sagard gives an excellent description of this woodpecker which he observed in the region in 1632. Head (1829) mentioned having shot one on April 11, [1815], at Kempenfelt Bay.

The Flicker is our commonest woodpecker, being well distributed throughout the county during the nesting season. Many breeding records are at hand. Mr. D. S. Miller found a bird excavating a nesting cavity at Oro as early as May 2 (1938). A nest containing eight eggs was found by Mr. W. W. Smith on May 11, 1941, at Big Cedar Point. A set of seven eggs collected by Mr. H. P. Bingham on May 30, 1920, at Little Lake is in R.O.M.Z., as is also a set of six eggs taken at Wasaga Beach by Dr. F. Starr on June 9, 1923. A nest containing large young was observed at Severn Falls on June 12, 1941; and another, also with young, was seen at McDonald Rapids on June 14, 1938.

The largest fall flights occur during September. At Holland River 15 birds were recorded on September 12, 1937, and 30 on September 11, 1938. Our latest autumn date is November 7 (1937), when one was encountered at Bradford.

The only available winter record concerns an individual that came to the feeding station of Mrs. G. W. Snell at Orillia for several winters beginning in 1937. However, this bird appeared to have an imperfect wing which may account for its failure to migrate as is the usual custom with this species.

Average date of spring arrival (10 years), April 20 (Collingwood); earliest, March 20, 1938 (Barrie).

2 ♂ ♂ August 15, 1887, Orillia.*
♂ August 24, 1935, Holland River, Bradford.

132. **Pileated Woodpecker.** *Ceophloeus pileatus.*—A fairly common resident; breeds. Undoubtedly the Pileated Woodpecker was a common species in the region prior to the coming of the settler. Head (1829) under date of April 13 [1815] states: "I shot one of the large species of woodpeckers, in size rather larger than a carrier pigeon, with a bright scarlet crest, called by the Canadians, 'cocks of the wood'. The Indians apply the scarlet feathers of this bird to many articles of ornament." With the cutting down of the forest, the species became rare except in the northern townships adjacent to Muskoka. It seems probable also that a remnant population managed to exist in some of the larger swamps such as Minesing, since Mr. R. Dunlop of Belvedere, Alberta, former resident of Barrie, recalled having seen several in the swamp on the Nottawasaga River above Edenvale, about 1888.

During the last fifteen years the Pileated Woodpecker has made a remarkable come-back probably largely as a result of protection. Also it has shown its ability to adapt itself to second-growth forest. A nest with young found by Mr. S. Watson near Orillia in 1915 has been recorded by Baillie and Harrington (1937). It was not until 1924-5, however, when Messrs. H. P. Bingham and H. B. Haugh reported it common near Barrie, that a marked increase was apparent. Since then, this fine bird has steadily increased in numbers. Much of its former range has been re-occupied and it is now generally distributed in suitable wooded sections throughout the county. Bingham (1933) recorded finding a nest with one egg at Craighurst on May 29, 1932. In 1940, four nests of this species were discovered near Barrie. These included one with three eggs by Mr. H. P. Bingham on May 15, near Crownhill; one with three eggs by Dr. Brereton on May 21; and two with eggs by Mr. D. Butler. On June 9, 1941, a nest containing large young was found by the writer in the 12th concession of Nottawasaga township, near Edward's Lake.

A specimen in the R.O.M.Z. collection was taken by Mr. J. Edmonds in East Oro in 1891.

♂ 1891, East Oro.*
♂ October 10, 1931, Minesing.
♂ September 20, 1934, Midhurst.*
♂ November 16, 1934, Port Severn.
♀ January 10, 1937, Barrie.*

133. **Red-headed Woodpecker.** *Melanerpes erythrocephalus.*—A rather rare spring and fall transient and summer resident; breeds sparingly. This handsome bird was formerly more numerous that at the present time. It is to be found frequenting open woods in farming communities in southern sections of the county.

In 1632, Sagard mentioned observing birds "which have the neck and head scarlet or crimson, and all the rest a very beautiful black and white. They are as big as a blackbird and are called 'Ouaiera.' A savage gave me a live one shortly before I left." Cabot (Agassiz, 1850), reported this species near Penetanguishene on August 21, 1848. Two birds observed near the village of Laurin, Tiny township, on August 3, 1936, marks the most northern point at which it has been noted by us, and it would appear that the species approaches the northern limits of its normal range in this locality.

As an indication of its former numbers, Mr. A. D. Henderson reports having discovered four nests near Little Lake in 1896; and Mr. L. A. Campbell found a nest of six eggs there on June 5, 1914, and one of seven eggs on May 30, 1915. An adult with young was seen by Dr. Harrington on July 1, 1923, at Wasaga Beach (Baillie and Harrington, 1937).

Our latest autumn occurrence is October 2 (1927), when one was noted at Stayner by Mr. J. L. Baillie and Dr. Harrington.

Average date of spring arrival (9 years), May 19 (Collingwood); earliest, May 5, 1914 (Collingwood).

? May 16, 1888, Orillia.* ? June 1, 1932, Little Lake.*

134. **Yellow-bellied Sapsucker.** *Sphyrapicus varius.*—A common spring and fairly common fall transient; fairly common summer resident in northern sections of the county, elsewhere rather rare at this season; breeds.

Spring migrants usually appear about mid-April, and the species continues common during the remainder of the month. In the fall it is a fairly common migrant during September. Dr. Harrington observed five at Wasaga Beach on September 29, 1928; and Mr. D. S. Miller noted it on September 22, 24 and 25, 1941, at Oro Station.

Baillie and Harrington (1937) have recorded a nest with four eggs at Minesing on June 7, 1928; a set of six eggs at Barrie found by H. P. Bingham on June 2, 1918; and an adult and young seen at DeGrassi Point by E. R. Hunter on July 10, 1933. A bird was noted excavating a nesting cavity at Holland River as early as May 2 (1937), while another similarly engaged was observed in the Minesing swamp on May 12 (1940). A nest containing young was located at the Holland River on July 1, 1936. At Severn Falls, where the species is common, two nests built in living aspens contained young on June 17, 1938.

Four specimens in the R.O.M.Z. collection taken by Dr. Walker at Orillia are listed below.

Average date of spring arrival (10 years), April 20 (Barrie); earliest, April 12, 1940 (Barrie).

? August 2, 1887, Orillia.*
♀ September 20, 1887, Orillia.*
♂ April 18, 1888, Orillia.*
♂ May 1, 1888, Orillia.*
♀ May 28, 1932, Little Lake.*
2 ♂ ♂ April 25, 1935, Gilford
♂ April 25, 1935, Holland River, Bradford.

135. **Hairy Woodpecker.** *Dryobates villosus.*—A common permanent resident in wooded regions; breeds. This well-distributed species is among our more common woodpeckers.

A set of five eggs taken by Dr. P. Harrington on May 3, 1922, at Wasaga Beach and a nest with young seen at Minesing on May 9, 1925, have been recorded by Baillie and Harrington (1937). Mr. R. D. Ussher found a nest with young at Buckskin Lake, near Severn Falls, on June 17, 1938. A nest containing young birds was observed at Holland River on June 12, 1939 In May, 1940, Dr. Brereton found three occupied nesting cavities of this species near Barrie.

A specimen in the R.O.M.Z. collection was taken by Dr. Walker at Orillia on May 12, 1888. Atkinson (1892) reported observing several birds at Holland River on October 21, 1890.

? May 12, 1888, Orillia.*
♂ December 13, 1925, Little Lake.*
♀ May 15, 1930, Little Lake.*
♂ November 19, 1932, Minesing
♂ May 6, 1934, Innisfil township
♂ June 10, 1937, Giant's Tomb Island.

136. **Downy Woodpecker.** *Dryobates pubescens.*—A common permanent resident. Next to the Flicker this is our commonest woodpecker. According to records of numbers kept over a long period of years, this species appears to outnumber the Hairy Woodpecker by approximately two to one.

It breeds commonly throughout the county. A set of six eggs taken by H. P. Bingham on May 23, 1915, at Barrie has been recorded by Baillie and Harrington (1937). It has been noted excavating a nesting cavity at Barrie as early as May 6 (1939). Egg dates range from May 22 to June 1. Mr. R. D. Ussher found a nest with young at West Bay, Sparrow Lake, on June 14, 1938; and young, out of the nest, were observed near Severn Falls on June 18, 1938. Mr. J. J. Baker found a nest containing two eggs on May 26, 1935, at Big Cedar Point; and Dr. Brereton located two occupied nesting cavities at Barrie on June 3, 1939.

Atkinson (1892) records having observed several at Holland River on October 21, 1890.

♂ December 13, 1936, Holland River, Bradford.
2 ♂ ♂ June 4, 1939, Barrie.*

137. **Arctic Three-toed Woodpecker.** *Picoides arcticus.*—An occasional winter visitant.

Young (1905) records having observed one at Penetanguishene on December 3, 1904, and another on February 17, 1905. A male was seen at Barrie by Dr. Brereton on March 11, 1939. Dr. P. Harrington has noted its occurrence at Wasaga Beach during the nesting season (MS) (June 13, 1924), but no positive evidence of its breeding in the county has come to our attention.

A male specimen taken at Dalston about 1910 is in the Debenham collection.

138. **Kingbird.** *Tyrannus tyrannus.*—A common spring and fall transient and summer resident; breeds. This species nests commonly in orchards and in the vicinity of water throughout the county. Dr. P. Harrington (MS) has found fresh eggs from June 6 to July 23, at Wasaga Beach and is of the opinion that in rare cases the Kingbird lays a second set of eggs. Twelve nests were found by him (Harrington, 1914) along the Nottawasaga River, over a distance of three miles from its mouth. Three nests with eggs were seen by the writer at Otter Lake, Matchedash township, on June 17, 1935, and four nests noted along the Severn River, near Severn Falls, in June, 1938. Half-grown young in the nest were found on July 3 (1938) at the Holland River. On August 4, 1941, young, out of the nest, being fed by parents were observed at Wasaga Beach.

The southward migration takes place during August and by September 1 only a few birds remain. Two individuals observed at Holland River on September 12, 1937, constitute our latest autumn record.

Average date of spring arrival (12 years), May 15 (Collingwood); earliest, May 2, 1942 (Little Lake).

? August 6, 1887, Orillia.*
? May 10, 1888, Orillia.*
♂ June 3, 1932, Little Lake.*
♀ May 22, 1932, Minesing.

139. **Crested Flycatcher.** *Myiarchus crinitus.*—A fairly common spring and fall transient and summer resident; breeds. The first spring arrivals appear early in May and the movement usually reaches its height between May 15 and May 27.

This well-distributed flycatcher nests in cavities in posts and trees throughout the county. Baillie and Harrington (1937) have recorded sets of four eggs taken by Dr. Harrington on June 18, 1922, and July 8, 1922, at Wasaga Beach and young, being fed by adults, seen by Mr. E. R. Hunter at De Grassi Point on July 28, 1933. Mr. H. P. Bingham found a nest with six eggs at Little Lake on June 7, 1937. Mr. W. W. Smith observed a nest of five eggs in a fence post at Big Cedar Point on June 16, 1940, while a similarly situated nest with three eggs was located in the same area by Mr. J. L. Baillie on June 7, 1942. A nest in a birch stub at Sparrow Lake was found by the writer to contain three small young on June 21, 1939.

The fall migration occurs during late August and early September. Six birds were seen at Holland River on September 12, 1937, and an individual noted there on September 15, 1940, establishes our latest autumn record.

Average date of spring arrival (8 years), May 11 (Holland River); earliest, May 1, 1941 (Barrie).

♀ July 8, 1930, Little Lake.* ♀ May 21, 1932, Minesing Swamp.
♂ September 8, 1935, Holland River, Bradford.

140. **Eastern Phoebe.** *Sayornis phoebe.*—A common spring and fall transient and summer resident; breeds. The earliest flycatcher to return in spring, the Phoebe usually appears during the first half of April, with an occasional bird sometimes appearing in late March.

It nests commonly under bridges, culverts and on buildings in the vicinity of water. The absence of suitable nesting sites somewhat restricts its occurrence in a few northern areas. Along the Severn River it is found nesting on rocky ledges overlooking the water; in such a situation a nest with five eggs was seen near the northern entrance to Tea Lake on June 17, 1938. Two broods are usually raised during the nesting season. Completed sets of eggs have been found on May 15, (1938), at Holland River, and Mr. H. P. Bingham has a set of six eggs taken at Barrie on May 7, 1938. Young in the nest were observed on May 24 (1938), at Wasaga Beach. Second broods hatch in late July (set of four hatched July 22, 1939, Wasaga Beach), and it is early August before these young are on the wing (August 9, 1933, De Grassi Point). On July 2, 1934, a nest with four eggs was found built in a cupboard in a deserted farmhouse near Jack's Lake. In order to reach the nest, the bird was compelled to fly through a broken window-pane.

The southward flight takes place mainly during September with a few stragglers lingering into October (latest October 17, 1937, Holland River).

Average date of spring arrival (9 years), April 10 (Holland River); earliest, March 22, 1939 (Holland River).

♂ May 13, 1930, Minesing.* ♀ April 25, 1935, Holland River, Bradford.
♀ October 17, 1937, Holland River, Bradford.

141. **Yellow-bellied Flycatcher.** *Empidonax flaviventris.*—An uncommon spring and fall transient. This inconspicuous little flycatcher passes through the region regularly, but in small numbers, in late May

and early June. An individual was observed by Mr. J. L. Baillie near Mac on May 21, 1932. It has been noted as late as June 7 (1929), by the same observer at Orr Lake. A bird seen by Dr. E. L. Brereton at Barrie on May 16, 1943, marks the earliest spring arrival date.

Few records of its southward migration are available. Several fall migrants were seen at Holland River on September 15, 1940, by members of the Toronto Ornithological Club. Dr. Brereton and the writer observed one bird at Wasaga Beach on September 7, 1942.

142 **Traill's Flycatcher.** *Empidonax trailli* —A fairly common summer resident; breeds. The first spring migrants usually arrive soon after mid-May, and by the end of the month they are to be heard singing from suitable alder or willow thickets throughout the county.

A nest and set of four eggs taken at Barrie on July 1, 1918, by Mr. H. B. Haugh are in the R.O.M.Z (Baillie and Harrington, 1937). Mr. H. P. Bingham found a nest containing four eggs of this species and one of the Cowbird on June 23, 1929, at Little Lake. At Big Cedar Point, Mr. W. W. Smith has found nests with full complements of four eggs on June 22 (1939). It is a regular breeding bird along the Holland River.

The fall migration is poorly defined, but the species becomes decidedly scarce in August and few if any remain by September 1.

Average date of spring arrival (5 years), May 29 (Collingwood); earliest, May 16, 1941 (Barrie).

♂ May 29, 1938, Holland River, Bradford

143. **Least Flycatcher.** *Empidonax minimus.*—A fairly common summer resident; breeds. The first spring birds usually appear during the second week of May. In the latter half of the month when the migration is at its peak, the explosive call note, "Chebec," is heard regularly from all suitable woodland.

In summer the Least Flycatcher occurs sparingly in southern sections of the county, being progressively more plentiful as one moves northward. It is particularly common in Matchedash township. Mr. A. D. Henderson collected a set of four eggs on June 2, 1894, and one of three eggs on June 25, 1896, at Barrie, where, also, a set of four eggs was taken on June 3, 1915, by Mr. H. P. Bingham; and Mr. J. M. Speirs saw young being fed by parents on June 30, 1937 (Baillie and Harrington, 1937). A nest found by the writer at Black Lake, Matchedash township, contained four heavily incubated eggs on June 18, 1935. Dr. G. E. Hobbs saw a nest with young on July 7, 1938, at Wasaga Beach. The young left this nest on July 12. On June 13, 1943, the writer was shown a nest of three eggs found by Mr. W. O'Connell, 25 feet up in a poplar, at Big Cedar Point.

The southward migration takes place during the latter half of August and early September. A singing individual identified at Holland River on September 15, 1940, by members of the Toronto Ornithological Club is our latest autumn record.

Average date of spring arrival (11 years), May 15 (Wasaga Beach); earliest, May 3, 1942, Big Cedar Point.

♂ June 12, 1937, Wasaga Beach.
♀ May 24, 1938, Batteaux Creek, Collingwood.

144. **Eastern Wood Pewee.** *Myiochanes virens.*—A common spring and fall transient and summer resident; breeds. The Wood Pewee is one of our commonest flycatchers, usually arriving from the south during the latter half of May. In summer its plaintive drawling song is one of the characteristic sounds of the drier woodlands.

It has been reported breeding at Wasaga Beach by Harrington (1915) and by Baillie and Harrington (1937). A nest (in R.O.M.Z.) taken at Penetanguishene on June 14, 1935, by Mr. C. E. Hope has been recorded by Baillie and Harrington (1937). The species was noted engaged in nest building at Wasaga Beach as early as June 9 (1935), and an apparently completed set of three eggs was found there on June 15 (1941). A nest containing four eggs was observed by Mr. D. S. Miller on August 1, 1936, at Oro Station; and Dr. E. M. Walker reported observing young on August 3, 1933, at DeGrassi Point. Dr. Brereton saw four young being fed by adults at Wasaga Beach, August 16, 1941.

The southward migration takes place in late August and early September. Our latest autumn date is September 20 (1942), when four individuals were observed at Big Cedar Point by members of the Toronto Ornithological Club.

Two specimens taken at Orillia by Dr. Walker on August 21, 1887, are in the R.O.M.Z. collection.

Average date of spring arrival (14 years), May 23 (Collingwood); earliest, May 13, 1940 (Barrie).

2 ? August 21, 1887, Orillia.*
♀ September 1, 1941, Holland River, Bradford.

145. **Olive-sided Flycatcher.** *Nuttallornis mesoleucus.*—An uncommon spring and fall transient and rare summer resident; breeds. Spring transients are in evidence towards the latter part of May. The great majority pass through to more northern forests, but a few pairs remain to breed in suitable black spruce stands within the region. One of the

few available nesting records was established at the Holland River, at the extreme southern boundary of the county, where the writer located a nest containing three eggs, 35 feet up in a black spruce, on June 15, 1940 (Devitt, 1941). At Wasaga Beach Dr. Brereton saw an adult feeding two young, out of the nest, on August 18, 1941.

This species has been noted in widely scattered localities in summer under conditions which would suggest breeding. The R.O.M.Z. survey party observed three birds near Penetanguishene, June 11-15, 1935, and Mr. R. D. Ussher and the writer found several frequenting a black spruce swamp near Severn Falls on June 17, 1938. Dr Harrington has noted it in summer (1929) at Marl Lake.

The southward movement takes place during the latter part of August and early September. At the Holland River, two were noted on September 12 (1937), and a single individual on September 15, 1940.

Average date of spring arrival (4 years), May 18 (Barrie); earliest, May 14, 1944 (Barrie).

♂ September 8, 1935, Holland River, Bradford.

146. **Horned Lark.** *Otocoris alpestris.*—A common spring and fall transient and fairly common summer resident; breeds. One of the first of the early migrants to return in spring, the Horned Lark usually appears in February before the snow has gone, at which time it is to be found frequenting bare patches of ground along beaches and roadsides. By early March it has become common and hundreds are to be seen daily.

Three races of this species have been determined as occurring in the county. The breeding form is the Prairie Horned Lark (*O. a. praticola*). In our experience this is the first race to return in spring, a male having been taken at Bradford on February 20, 1938. These birds appear to be already paired off and the males defending breeding territories when flocks of the larger, brighter Northern Horned Larks (*O. a. alpestris*) pass through the region. That this movement is of considerable duration may be adjudged from a flock of 30 birds observed by Dr. Brereton, near Stayner, as late as May 3 (1941); a male taken on this occasion appears to be typical of the form *alpestris*.

The difficulty of accurately identifying Hoyt's Horned Lark (*O. a. hoyti*) in the field makes it practically impossible to obtain a true picture of its relative abundance, but it probably occurs in small numbers along with the flocks of *alpestris*. A male specimen taken by the writer from a flock of 25 larks on April 26, 1936, near Elmvale, was determined to be *hoyti* by the late Mr. J. H. Fleming.

The Prairie Horned Lark is a fairly common breeding bird in farming communities. Bingham (1929) records finding a nest with three eggs on April 19, 1925, at Barrie. The young hatched on April 20, only to perish in a late snowfall. Mr. D. Butler located three nests with eggs on May 12, 1940, at Essa Station, and in the same locality Dr. Brereton saw two young being fed by adults on May 21, 1940.

The first autumn migrants begin to pass through the county about the middle of September and the movement continues throughout October. Two individuals observed at Holland River on October 31, 1937, constitute our latest fall record.

Average date of spring arrival (9 years), February 25 (Barrie); earliest, February 2, 1918 (Collingwood).

♂ March 10, 1934, Innisfil township.
♂ April 26, 1936, Elmvale.
♂ February 20, 1938, Bradford.
♂ May 3, 1941, Stayner.

147. **Tree Swallow.** *Iridoprocne bicolor.*—A very common spring and fall transient and common summer resident; breeds. This is the first swallow to return in spring, early arrivals usually appearing about mid-April. The peak of the migration occurs between May 10 and 20, when hundreds are to be seen daily; an estimated 500 were observed by Dr. Brereton at Little Lake on May 15, 1939.

The Tree Swallow breeds commonly in suitable cavities in trees and posts and in bird boxes about dwellings. Its nesting at Collingwood (1920), Little Lake (1922) and DeGrassi Point (1936) has been recorded by Baillie and Harrington (1937). At Wasaga Beach a pair engaged in nest building was noted as early as May 10 (1936). Egg dates range from May 21 (set of four found at Little Lake by Mr. H. P. Bingham in 1922) to July 3 (set of four seen in Innisfil township by Mr. G. Lambert in 1939). Young in the nest have been noted from June 11 (1940), at Severn Falls, to as late as July 21 (1940), in Innisfil township.

Flocking preparatory to leaving for the south begins about mid-July and gradually increasing numbers are to be seen gathered on wires along roadways as the season advances. On August 3, 1936, a flock estimated at over 3000 birds was observed near Wyevale. The southward movement continues throughout August and to a lesser degree during the first half of September. A flock of 50 birds noted at Victoria Harbour by Mr. W. W. Gunn on September 27, 1938, constitutes our latest autumn record.

Average date of spring arrival (15 years), April 21 (Collingwood); earliest, April 8, 1937 (Holland River).

? May 8, 1888, Orillia.*
? May 5, 1925, Little Lake.*
♂ May 22, 1932, Minesing.*

148. **Bank Swallow.** *Riparia riparia.*—A very common spring and fall transient and summer resident; breeds. The first spring migrants are in evidence about the first week of May, and the peak of the movement takes place between May 10 and 20.

With the exception of the rocky region along the Severn River, where the nesting habitat is restricted, this species is a very common breeding bird in suitable banks throughout the county. Nest building is commenced soon after arrival and birds have been seen as early as May 15 (1938), excavating nesting holes in sandbanks along the Nottawasaga River in the vicinity of Minesing Swamp. Colonies vary greatly in size from a few pairs to many hundreds. Probably the largest colonies in the county are to be found in the high sandy banks along the Nottawasaga River. One particular bank near Oakview has an annual nesting population of between 400 and 500 pairs. Nests with completed sets of eggs have been found from May 23 (set of six taken at Little Lake in 1937 by Mr. H. P. Bingham) to July 2 (set of four, Sunnidale township, 1934). Young, out of the nest, have been observed as early as June 24 (1933), at Oakview.

Flocking begins early in July, when groups are to be seen perched on telephone wires or flying over the marshes. Hundreds were observed going to roost for the night in the Holland River Marsh on July 9, 1941. Flocks reach considerable proportions in early August as witnessed by 1500 birds at Wyevale on August 3, 1936, and 3000 at Bradford on August 11, 1935. By September 1, only a few remain. A single bird, seen at Holland River on September 11, 1937, is our latest fall record.

Average date of spring arrival (12 years), May 9 (Collingwood); earliest, April 29, 1942 (Barrie).

♂ August 3, 1936, Wyevale.

149. **American Rough-winged Swallow.** *Stelgidopteryx ruficollis.*—An uncommon transient and summer resident; breeds. Early spring migrants usually appear during the last week of April and the movement continues until about May 15.

The Rough-winged Swallow is an uncommon breeder in the southern half of the county, usually as solitary pairs but occasionally up to half a dozen pairs will occupy the same bank. It is relatively scarce north of the townships of Oro and Flos. Dr. Harrington collected a set of four eggs at Wasaga Beach on July 1, 1928, and Mr. H. P. Bingham took a set of four eggs at Barrie on June 13, 1918 (Baillie and Harrington, 1937). Several pairs, which have nested each year for six years in a gravel bank at Holland River, have been seen excavating nesting holes as early as May 10 (1942). A cavity examined there on July 1 (1936) contained recently hatched young. Dr. E. M. Walker noted a pair nesting in a colony of Bank Swallows at DeGrassi Point on June 3, 1934. In the ninth concession of Innisfil township, Mr. G. Lambert found a nest of six eggs on June 25, 1939, and large young in another nest on July 21, 1940.

An apparent southward movement was observed on July 17, 1937, when ten birds were seen flying southwest over the Holland River Marsh. A few Rough-wings are usually to be seen mixed with the large flocks of Tree, Bank and Barn Swallows which assemble in July and August prior to leaving for the south. A concentration of 60 birds noted by Mr. J. L. Baillie on telephone wires at Big Cedar Point on September 12, 1943, constitutes our latest autumn record.

Average date of spring arrival (7 years), April 29 (Barrie); earliest, April 19, 1938 (Barrie).

♀ May 24, 1937, Wasaga Beach.

150. **Barn Swallow.** . *Hirundo erythrogaster.*—A common spring and fall transient and summer resident; breeds. This species usually arrives from the south during the latter part of April and becomes a common migrant between May 10 and 20.

It is well distributed in summer, breeding commonly where suitable barns or other buildings are available. Nests are sometimes found built under bridges. Two broods are usually raised in a season. Atkinson (1892) records finding a nest containing four eggs at Orillia on May 26, 1890. Its breeding at Marl and Orr Lakes (1929) and at Barrie (1916) has been recorded by Baillie and Harrington (1937). Dates for fresh eggs range from May 26 (1890) to June 21 (1935). Young in the nest have been noted as early as June 12 (1935), at Severn Falls; and young birds on the wing have been seen on July 7 (1935), at Collingwood. Mr. E. R. Hunter has observed young being fed by parents as late as August 5 (1935), at DeGrassi Point.

This species has been seen flocking by July 16 (1938), at the Holland River Marsh. The numbers increase until hundreds may be noted strung out along telephone wires in early August. The great majority have moved south by September 1, and only small flocks remain until the middle of the month (latest, September 15, 1940, Holland River).

Average date of spring arrival (12 years), April 30 (Collingwood); earliest, April 18, 1937 (Wasaga Beach).

? May 29, 1932, Little Lake.*

151. **Cliff Swallow.** *Petrochelidon albifrons.*—An uncommon spring and fall transient and summer resident; breeds. Undoubtedly our

rarest swallow, this species arrives slightly later than other members of the family, rarely putting in an appearance before mid-May. Numbers recorded are never large.

The Cliff or Eave Swallow is subject to considerable fluctuation in its nesting locale, being present in an area one season and absent the next. It is sporadically distributed during any summer. Available evidence of its nesting concerns at least ten localities scattered throughout the county. Dr. Harrington located a breeding colony at Marl Lake on June 27, 1913 (MS). No others were noted there until 1929, when five nests with four and five eggs were found on June 3, by Baillie and Harrington (1937). At Wasdell Falls, Severn River, a colony of 13 nests, built on the walls of the Hydro power building, was found on July 13, 1936, by Mr. D. Hassell and Mr. B. Ronald. Six occupied nests were observed there by the writer on July 21, 1939. Mr. W. W. Gunn reported two pairs nesting at Orillia on June 16, 1939, and six nests were observed on a barn near Washago on July 17, 1939. Dr. Brereton discovered two and four pairs, respectively, nesting on barns at Mud Lake, near Anten Mills, on July 6, 1941. Other colonies have been reported at Port Severn, Big Cedar Point, Churchill, and Glenwood Beach, Lake Simcoe.

A few Cliff Swallows usually are to be noted in the large flocks of Barn, Bank and Tree Swallows which assemble along the telephone wires in July and August. Three individuals observed at Bradford on September 11, 1938, by Messrs. D. S. Miller and J. M. Speirs constitute our latest autumn record.

Average date of spring arrival (6 years), May 15 (Barrie); earliest, May 6, 1939 (Barrie).

♂ June 2, 1932, Little Lake.*

152. **Purple Martin.** *Progne subis.*—A fairly common spring and fall transient and summer resident; breeds. One of the earliest swallows to arrive in the spring, the Purple Martin appears soon after the middle of April.

This well-distributed species nests locally, in colonies, about buildings in towns and villages or in nesting boxes provided for its use. Baillie and Harrington (1937) have recorded a set of five eggs taken at Barrie on June 8, 1916, by H. P. Bingham; a nest with four young found at Midland by R. Stanfield on July 17, 1935, and four pairs breeding at Hawkestone in 1936, found by A. M. Patterson. It breeds regularly about buildings in Collingwood, Stayner, Elmvale and Orillia, while colonies established in bird-houses have been observed in Bradford, (1939), Barrie (1938), Lisle (1939) and Glenwood Beach (1939).

The southward migration takes place in August and early September. At Barrie, Dr. Brereton reported that the birds departed from a local martin house on August 19 (1938). A single individual noted on September 15, 1940, at Holland River is our latest autumn record.

Average date of spring arrival (9 years), April 26 (Barrie); earliest, April 18, 1917 (Barrie).

♀ June 4, 1938, Barrie.

153. **Canada Jay.** *Perisoreus canadensis.*—A rare winter visitant. The normal range of this species is beyond the northern limits of the county and only occasionally does it wander within our boundaries. Flights have occurred in which it has invaded Southern Ontario in numbers. Such was the case during the winter of 1904-5, when a southward flight of considerable proportions took place. Fleming (1905), recording "An unusual migration of the Canada Jay", quotes Mr. A. F. Young of Penetanguishene to the effect that "one or two were seen every day from October 25 to 30, November 12 and November 26, 1904, also on January 9 and 20, 1905." Two mounted specimens in the Debenham collection were taken at Dalston about this time. During the flight which occurred in 1929, Mr. H. B. Haugh reported it common at Little Lake in November, and took a male specimen on April 7, 1930, now in the R.O.M.Z.

The winter of 1941-2 was the occasion for another Canada Jay invasion into Southern Ontario. The first evidence of this flight having reached the county came from Woodland Beach, Nottawasaga Bay, on September 21, 1941, where twelve or more birds were observed by Miss Joan Funnell and Mr. H. Iddon. Dr. F. A. Clarkson reported two individuals at Hawkestone on October 13; Mr. H. P. Bingham recorded four birds near Elmvale on October 14, and four at Barrie on October 16; and Dr. Brereton took specimens on October 25 and November 15. By late October it was evident that this incursion was widespread and of large proportions. Brereton and Laws (1942) reported two individuals at Barrie on December 26, 1941. Reports of Canada Jays in various parts of the county were received throughout the winter and into the early spring months. A single bird observed at Wasaga Beach by Dr. Brereton on April 19, 1942, was the last to be recorded.

♂ April 7, 1930, Little Lake.*
♀ October 25, 1941, Barrie.
♂ November 15, 1941, Phelpston.
♂ November 15, 1941, Barrie.

154. **Blue Jay.** *Cyanocitta cristata.*—A fairly common permanent resident; breeds. Head (1829) tells of shooting a specimen from a noisy flock of 20 to 30 birds at Kempenfelt Bay on March 18 [1815].

The species was noted by Louis Agassiz at Sturgeon Bay on August 21, 1848. A "Correspondent" to the *Canadian Naturalist and Geologist* mentions the Blue Jay as being present at Barrie in 1858. Starr (1923) reported it common in the Georgian Bay district and found a nest containing five fresh eggs on June 9, 1923.

While the Blue Jay is present in the county throughout the year, there is a definite migratory movement in May and September probably by birds which summer farther north. At Wasaga Beach, Dr. Harrington (MS) writes of enormous flocks being present from May 3 to 20, 1922; and on May 6, 1934, the writer witnessed a flight of 110 birds which passed in a loose flock in a northeasterly direction along the beach. Again, on May 10, 1936, several flocks of approximately 50 birds each were seen flying east along the shore. Evidence of a southward migration was observed at Holland River on September 11, 1937, when 25 individuals were seen; and again on September 11, 1938, when 36 were noted. A flock of 30 birds was observed flying southwest at Wasaga Beach on September 21, 1941.

This species breeds fairly commonly in wooded sections of the county. A nest with five eggs was found as early as May 1 (1938) at Big Cedar Point by Mr. W. W. Smith, and young in the nest have been noted there on several occasions in June, from June 2 (1935) to as late as June 23 (1940). A set of five eggs in the writer's collection was found by Mr. R. D. Ussher at Tea Lake on June 15, 1938.

Atkinson (1892) reported securing a specimen at Holland River on October 21, 1890.

? September 22, 1887, Orillia.*
? October 13, 1894, Barrie.*
♂ March 9, 1925, Little Lake.*
Juv. ♂ June 13, 1935, Penetanguishene.*
♀ May 5, 1934, Innisfil township.
♂ July 26, 1936, Holland River, Bradford.

155. **Raven.** *Corvus corax.*—Undoubtedly a former resident of the county, the Raven has long since retired beyond the limits of settlement and can only be regarded as an accidental visitant at the present time. In a list of birds stated as occurring at Orillia, W. Melville (1892) reported securing a fine specimen of Raven in December, 1890.

While observing birds at Kempenfelt Bay, Barrie, in the spring of 1929, Mr. H. P. Bingham saw two large black birds flying in a northerly direction closely pursued by a flock of Crows. He recognized them at once as Ravens and heard their hoarse, croaking calls uttered when repeatedly dived at by their pursuers. They disappeared to the north, still followed by the tormenting Crows. A more recent record concerns a Raven which was shot a few miles west of Collingwood, near the boundary of Grey County, by Messrs. E. L. Durkin and Edward Hart of Meaford on October 20, 1943. The specimen was identified by Mr. L. H. Beamer and is now in the collection of the Meaford High School.

156. **American Crow.** *Corvus brachyrhynchos.*—A very common spring and fall transient and summer resident, and a rare winter visitant; breeds. In the 17th century Sagard (Wrong and Langton, 1939) tells of the Huron Indians attempting to snare Crows which came to eat the corn at seed-time. One of the earliest spring migrants, this species usually appears in late February, with the migration reaching its height in March. The southward movement takes place during September and October when loose flocks numbering hundreds of individuals are to be seen.

A few birds occasionally remain in the region during open winters. Young (1905) reported observing four Crows at Penetanguishene on January 21, 1905. Two were noted at Bradford on December 28, 1937, by Messrs. W. V. Crich and J. M. Speirs; and Dr. Brereton saw one at Barrie on January 1, 1940. Two individuals observed at Barrillia Park, near Hawkestone, by Mr. W. W. Gunn on February 14, 1938, were probably early migrants.

Crows carrying nesting material have been noted at the Holland River as early as April 7 (1940); and nests with full complements of eggs have been found on April 15 (1938) at Big Cedar Point by Mr. W. W. Smith. Young in the nest have been noted by May 11 (1941) to as late as July 3 (1939), in Innisfil township. Early broods of young are on the wing by the end of the first week of June.

Average date of spring arrival (14 years), March 5 (Collingwood).

♀ May 17, 1931, Mincsing.*
2 Juv. ♂ ♂ May 21, 1932, Minesing.
♀ March 12, 1925, Little Lake.*
♂ April 10, 1936, Holland River, Bradford.

157. **Black-capped Chickadee.** *Penthestes atricapillus.*—A common permanent resident; breeds.

The earliest reference to this species in the county is that given by a "Correspondent" in the *Canadian Naturalist and Geologist* in which it was reported as being "seen almost every day" at Barrie during the winter of 1858. Macoun (1904), quoting A. F. Young, states that it is "an abundant resident at Penetanguishene."

It nests commonly in suitable cavities in rotten stubs and posts throughout the region. Starr (1923) reported it common in the Georgian Bay district and found a nest with young on June 9, 1923. Its breeding at Barrie and Wasaga Beach has been recorded by Baillie and Harrington

(1937). A pair engaged in nest building was observed at Little Lake as early as April 19 (1941) by Dr. Brereton; this nest contained eight eggs on May 11. Dates for completed sets of eggs range from May 9 (set of seven eggs found by H. P. Bingham at Barrie in 1915) to June 18 (set of six eggs found by Dr. Harrington at Wasaga Beach in 1920). Fully fledged young about ready to leave the nest were observed on June 9 (1921) by Dr. Harrington at Wasaga Beach. A family group with young not long out of the nest was seen by the writer at Severn Falls on June 18, 1938.

Large numbers of Black-capped Chickadees occasionally invade towns and villages during the fall and winter. Such was the case on October 20, 1933, when an unusual flight was witnessed at Barrie by Dr. Brereton. For three or four days the town, even to the business sections, was alive with these birds. The general movement was westward following the shoreline, then southward from the head of the bay. A similar southward movement was noted at Barrie on October 13, 1941, when an estimated 1000 birds passed by in two hours.

? April 24, 1888, Orillia.*
? December 2, 1925, Little Lake.*
♀ March 27, 1930, Little Lake.*
♂ February 10, 1935, Wasaga Beach.
♀ April 25, 1935, Holland River, Bradford.

158. **Brown-headed Chickadee.** *Penthestes hudsonicus.*—A very rare fall and winter visitant from the north. A flight of these birds occurred during the fall of 1937, when they were reported from points as far south as Toronto and King, York County. On October 31, 1937, two individuals were noted at Holland River and a male secured by the writer. The specimen was examined by Mr. P. A. Taverner who has referred it to the Hudsonian race (***Penthestes hudsonicus hudsonicus***). Other reports came from Barrie, where Dr. Brereton saw two individuals on December 18, 1937, and Major Mark Robinson observed three birds at his feeding station on December 25 (1937). In 1942, individual birds were reported at Barrie by Dr. Brereton on January 17 and March 7.

♂ October 31, 1937, Holland River, Bradford.

159. **White-breasted Nuthatch.** *Sitta carolinensis.*—A fairly common permanent resident; breeds. This species is not particularly conspicuous during the summer months but seems to become commoner in the fall and winter, at which time it tends to wander about to some extent. Macoun (1904) quotes Mr. A. F. Young who considered it "a common resident at Penetanguishene."

A set of eight eggs taken on May 9, 1915, by H. P. Bingham at Barrie has been recorded by Baillie and Harrington (1937). On June 21, 1939, an adult and three young were observed at Wasdell Falls. Apparently the young were just out of the nest and were content to cling quietly to the limb of a tree. Later in the day they were seen on the move, feeding through the nearby woods. A nest containing young was found by Dr. Brereton on May 22, 1940, in Oro township, near Barrie.

A specimen taken at Orillia by Dr. Walker on April 24, 1888, and a female taken at Peninsular Park, Barrie, by Mr. W. G. A. Lambe on October 13, 1894, are in the R.O.M.Z.

? April 24, 1888, Orillia.*
♀ October 13, 1894, Barrie.*
♂ March 5, 1930, Little Lake.*
♀ November 24, 1935, Holland River, Bradford.

160. **Red-breasted Nuthatch.** *Sitta canadensis.*—A fairly common spring and fall transient; uncommon winter visitant and a rather rare summer resident; breeds. With some birds usually present throughout the winter, it is difficult to ascertain when the first spring migrants arrive, but the species becomes generally more plentiful during the first half of May. In the autumn a noticeable increase in numbers is apparent about the second week of September.

A brood of four young (just hatched) was found by Dr. Harrington at Wasaga Beach on June 15, 1928 (Baillie and Harrington, 1937). Dr. Brereton located a nesting cavity containing young which were being fed by parents at Barrie on May 24, 1938. The entrance hole was 40 feet up the trunk of a partly dead white pine. Its presence in the nesting season in such localities as Holland River, Oro, Edward's Lake, Black Lake and Severn Falls lends support to the belief that this species may be commoner as a breeding bird than is generally supposed.

A flight of considerable proportions took place in the fall of 1937, and unprecedented numbers of these birds remained in many sections of Southern Ontario during the ensuing winter. The first evidence of the southward movement was noted on September 5 at Wasaga Beach, when seven individuals were seen. At Holland River, ten birds were observed on September 12, and fifteen on November 7. They were seen regularly during the winter, ten being noted on December 1 and five on January 16 (1938). Mr. W. W. Gunn found five at Barrie on February 19 (1938). Reports from adjacent counties revealed unusually large numbers wintering (40 were reported by Mr. R. D. Ussher at King, York County).

? September 30, 1887, Orillia.*
♂ October 11, 1924, Wasaga Beach.*
♂ September 22, 1935, Wasaga Beach.

161. **Brown Creeper.** *Certhia familiaris.*—A fairly common spring and fall transient and an uncommon winter visitant; rather rare summer resident; breeds. Although present throughout the year, this species is more often observed during the spring and fall migrations. It is inconspicuous and locally distributed in dense woods during the summer months. The peak of the spring movement occurs between April 7 and 30. In the autumn, the period of maximum numbers is from September 20 to October 20.

A "Correspondent" writing in the *Canadian Naturalist and Geologist* states that "Tree creepers . . . were seen almost every day" during the winter of 1858, at Barrie. It was reported by A. F. Young (Macoun, 1904) to be "a common resident at Penetanguishene."

Mr. H. P. Bingham found a nest containing six eggs on May 23, 1915, at Barrie (Baillie and Harrington, 1937). This is the only available breeding record although the Brown Creeper has been noted during the nesting season at Little Lake, Wasaga Beach, Cranberry Lake and Lefroy.

Along the southern boundary of the Holland River Swamp in adjacent King township, York County, a nest containing five young was shown to the writer by Mr. R. D. Ussher on July 1, 1937.

♂ October 15, 1936, Wasaga Beach.

162. **House Wren.** *Troglodytes aedon.*—A common spring and fall transient and summer resident; breeds. The first spring migrants usually appear about the last week of April or the first few days of May. Dr. Brereton has noted it at Barrie as early as April 24 (1938). By the end of the third week of May, the migration is virtually over.

This familiar bird nests commonly in bird boxes about habitations and in cavities in posts or tree stubs throughout the county. Usually two and possibly three broods are raised in a season. Harrington (1914) reported finding a nest with four fresh eggs at Wasaga Beach on July 1, 1913; and birds engaged in nest building have been noted there as early as May 14 (1933). Egg dates range from May 21 (set of six found at Little Lake by Mr. D. Butler in 1938) to August 1 (set of seven found at Alcona Beach, Lake Simcoe, by Mr. G. Lambert in 1939). Dr. Harrington has noted newly hatched young in the nest by June 15, at Wasaga Beach; the young left this nest on June 27. The first egg of a second set was laid on July 2 (while first young were still being fed), and the clutch of six eggs completed on July 7. This species has been observed nesting in damp woods at the Holland River (set of six eggs in stub, May 29, 1938). Occupied nests were noted at Severn Falls (June 13, 1938), Thunder Bay (June 9, 1937) and Grass

Lake (June 21, 1936). A late breeding record concerns a nest of half-grown young found by Mr. W. W. Smith on August 23, 1942, at Big Cedar Point.

The House Wren becomes inconspicuous in August, at which time it generally retires to the seclusion of wooded areas. The southward migration takes place mainly during September. An individual noted at Wasaga Beach by Dr. Harrington on September 28, 1928, is our latest autumn record.

Average date of spring arrival (14 years), May 3 (Collingwood).

? May 12, 1888, Orillia.*
♀ June 2, 1932, Little Lake.*
♂ July 1, 1932, Holland River, Bradford.

163. **Winter Wren.** *Nannus hiemalis.*—An uncommon spring and fall transient and summer resident, rare winter visitant; breeds. The first spring migrants usually arrive about mid-April, when their melodious ringing songs are to be heard emanating from the depths of some swampy woods. The northern movement continues until about the middle of May.

This dark little wren is rather locally distributed in summer. Baillie and Harrington (1937) reported taking a young bird from a brood on June 5, 1929, at Cranberry Lake. It breeds regularly in swampy white cedar woods along the Holland River, and a brood of four young not long out of the nest was observed there on July 1, 1936. Dr. Brereton saw three young, out of the nest, being fed by parents at Little Lake on June 19, 1938. It is probable that this species raises two broods in a season, seeing that a family group consisting of an adult and four young, out of the nest, was encountered at Holland River as late as September 12 (1937), and a specimen of young secured. It has also been observed during the breeding season at DeGrassi Point and Wasaga Beach.

There are several winter observations. A specimen taken on December 16, 1925, by Mr. H. B. Haugh is in the R.O.M.Z., and Dr. Brereton saw an individual at Willow Creek, near Midhurst, on February, 18, 1939.

Swainson and Richardson (1831) reported taking a specimen in the vicinity of Penetanguishene in April, 1825.

Average date of spring arrival (7 years), April 19 (Collingwood).

? December 16, 1925, Little Lake.*
♂ October 20, 1935, Holland River, Bradford.
Juv. ♂ September 12, 1937, Holland River, Bradford.

164. **Long-billed Marsh Wren.** *Telmatodytes palustris.*—A common summer resident; breeds. The first early spring migrants arrive about the second week of May, and by the end of the month the great majority have established themselves in suitable cat-tail marshes throughout the county.

The fall migration takes place mainly in September with a few stragglers lingering into October. Two individuals observed at Collingwood on October 9, 1939, constitute our latest autumn record.

The Long-billed Marsh Wren has a decided preference for cat-tail marshes and during the breeding season is almost wholly confined to this type of habitat. Mr. H. P. Bingham has found nests with completed sets of eggs as early as May 28 (1938), at Little Lake, and a late set of five eggs taken by him on August 15, 1915, is in the R.O.M.Z. Mr. R. A. Smith and the writer found ten nests and collected a set of six eggs at Otter Lake, Matchedash township, on June 17, 1935 (Baillie and Harrington, 1937). The species appears to approach the northern limits of its normal range in this locality. Snyder (1930) and Ussher (1939) have reported it common in the marshes along the Holland River and there Messrs. W. V. Crich and R. D. Ussher found three nests, containing four and five eggs, on June 9, 1938. Nests with young birds were found on June 23 (1939), at Marl Lake. Other breeding colonies of this wren are located at Grass Lake, Fesserton, Waubaushene and DeGrassi Point.

Average date of spring arrival (5 years), May 17 (Little Lake); earliest, May 8, 1938 (Holland River).

♂ July 19, 1930, Little Lake.*	♂ June 17, 1935, Otter Lake.

165. **Short-billed Marsh Wren.** *Cistothorus stellaris.*—A fairly common summer resident; breeds. This species arrives from the south about the middle of May, but it is the end of the month before the main body of summer residents have occupied their territories. The Short-billed Marsh Wren prefers somewhat drier situations than the preceding species, being found in damp, grassy meadows and in the outer borders of marshes. Its choice of this type of habitat has a localizing effect on its distribution in the county; moreover, it is rather irregular in its selection of nesting sites and is not always present in a given locality on successive years.

Bingham (1923) reported finding a nest with six eggs, three miles from Barrie, about June 1, 1922, and later, seven nests with young. A set of eight eggs found at Cranberry Lake on June 12, 1929, by Dr. Harrington, and a set of seven eggs (in R.O.M.Z.) found by the writer at Marl Lake on July 15, 1934, have been recorded by Baillie and Harrington (1937). This species is a common breeding bird in the drier portions of the Holland River Marsh (Snyder, 1930, and Ussher, 1939); a nest containing three eggs was found there by Messrs. W. V. Crich and R. D. Ussher (near Bradford) on June 9, 1938. In the flats just north of the village of Phelpston, where a small colony is to be found, Dr. Harrington located a nest with six young on June 14, 1929; as many as ten singing males were noted there by the writer on June 23, 1939. A colony of eight pairs was discovered occupying a damp meadow at the northern limits of the Beeton Swamp on July 15, 1939. It was found to be a common inhabitant of the grassy sloughs existing in rocky depressions in the vicinity of Severn Falls and Port Severn during field work in these areas in 1938 and 1941.

The Short-billed Marsh Wren is seldom recorded away from its breeding habitat and little is known of its migratory movements. Our latest autumn date is September 14 (1937), when ten individuals were still present at the Holland River Marsh.

Average date of spring arrival (3 years), May 17 (Barrie); earliest, May 16, 1939 (Barrie).

♂ June 4, 1929, Minesing.* ♂ May 17, 1931, Minesing.
2 ♂ ♂ August 14, 1937, Holland River, Bradford.

Hypothetical.

Mockingbird. *Mimus polyglottos.*—On May 24, 1941, Mr. John Baker and Mr. Robert Pyle reported observing an individual of this species at Big Cedar Point. It was comparatively tame and permitted close approach. Their description seemed clearly to indicate a Mockingbird. However, before admitting so unlikely a species to the county list, the writer feels that it should be sustained by more positive evidence. Consequently, the Mockingbird is here considered hypothetical.

166. **Catbird.** *Dumetella carolinensis.*—A common spring and fall transient and summer resident; breeds. Mr. A. F. Young (Macoun, 1904) reported it to be "a very common summer resident at Penetanguishene." Early spring migrants usually appear about the last week of April, and the movement continues until mid-May.

This well-distributed species breeds commonly throughout the county, raising several broods in a season. It is to be found frequenting bushy thickets especially along waterways. A nest with four eggs (in R.O.M.Z.) taken at Little Lake on May 28, 1919, by Mr. H. P. Bingham and a set of four eggs secured by Dr. Harrington on July 27, 1915, at Wasaga Beach, have been reported by Baillie and Harrington

(1937). The foregoing records represent extreme dates for completed sets of fresh eggs. At Big Cedar Point,a completed set of four eggs was found by the writer on June 1 (1941), while at Wasaga Beach the earliest date for fresh eggs is June 3 (1930), set of four. Young in the nest have been seen as early as June 19 (1934), at Wasaga Beach; and Mr. G. Lambert found young about ready to fly as late as July 21 (1940), in Innisfil township. It is a fairly common species along the Severn River, where a nest containing three eggs was found near Tea Lake by Mr. R. D. Ussher on June 15, 1938. Mr. W. W. Gunn reported observing a nest with four eggs at Orillia on June 16, 1939.

The southward movement takes place during September and early October. An individual noted at Batteaux Creek, Collingwood, on October 9, 1939, is our latest fall record.

Average date of spring arrival (11 years), May 11 (Collingwood); earliest, April 23, 1941 (Barrie).

? July 22, 1887, Severn River *
? May 12, 1888, Orillia.*
♂ May 13, 1930, Minesing.*
♀ September 2, 1935, Batteaux Creek, Collingwood.

167. **Brown Thrasher.** *Toxostoma rufum.*—A fairly common transient and summer resident; breeds. It is usually the latter part of April when the first spring migrants appear, but May is well advanced before the males become conspicuous with their beautiful songs. Mr. A. F. Young (Macoun, 1904) reported it to be a common summer resident at Penetanguishene and mentions having observed nests. It was found to be rather common in the Severn Falls-Tea Lake area in 1938, as many as ten individuals having been recorded in a day (June 18).

The Brown Thrasher is a fairly common breeding bird in the drier bush-covered pasture and waste lands throughout the county. Nidification is under way as early as May 17 (1936), when a nest with one egg was found at Big Cedar Point by Mr. J. J. Baker. Mr. H. P. Bingham took a set of four eggs on May 26, 1930, at Barrie, and Mr. C. E. G. Molony located a nest containing three eggs near Jack's Lake on July 2, 1934. Young in the nest have been found as early as June 2 (1935) by Mr. Baker at Big Cedar Point. In a nest found at Wasaga Beach by the writer the young were observed breaking through the shells on June 12. At Fesserton a nest containing four young was shown to me by Mr. K. Rose on June 16, 1939.

The southward migration takes place mainly in September. An individual noted by Mr. J. L. Baillie at Wasaga Beach on October 2, 1927, is our latest autumn record.

Average date of spring arrival (6 years), April 29 (Barrie); earliest, April 22, 1941 (Barrie).

♀ June 2, 1932, Little Lake.*	♀ June 16, 1938, Tea Lake.

168. **American Robin.** *Turdus migratorius.*—A very common spring and fall transient and summer resident, and a rather rare winter visitant; breeds. One of the commonest and best known birds in the county. The first wave of spring migrants usually appears about the middle of March. A marked increase in numbers is evident about the first week of April, and the period of maximum numbers extends to about April 16. An early record of interest because it concerns the period before the land was deforested is that of Head (1829), who mentions having shot one at Kempenfelt Bay on April 15 [1815].

The Robin breeds abundantly throughout the region, particularly in the vicinity of habitations, and nests are sometimes found in deep woods far removed from the settlements of man. Usually two broods are raised in a season. Lawrence (1927) reported examining a set of four eggs at Barrie on May 18, 1927, in which two of the eggs were spotted. Baillie and Harrington (1937) have recorded it nesting at Barrie, Wasaga Beach and Minesing. Nest construction is commenced the latter part of April, and a completed set of four eggs (in R.O.M.Z.) was taken as early as May 5 (1920) at Barrie by Mr. H. P. Bingham. A nest containing a single egg was noted on May 1 (1938), at Wasaga Beach. A brood of three newly hatched young was found at Holland River on May 8 (1938), the eggs of which must have been laid in late April. Mr. G. Lambert found a set of four eggs at Glenwood Beach, Lake Simcoe, on August 10, 1939, and Dr. P. Harrington observed a Robin incubating as late at August 28 (1943) at Wasaga Beach. Fully fledged young, out of the nest, have been observed as early as May 24 (1941), at Wasaga Beach.

Small groups of ten to fifteen birds have been noted flocking as early as August 16. Larger flocks containing upwards of fifty individuals are in evidence in September and the peak of the fall migration occurs during the last week of that month and the first two weeks of October. By November 1, all have departed except a few stragglers and those individuals which intend to remain during the winter.

Records of wintering Robins are not plentiful but a few are usually reported each winter. It has been noted at Collingwood by Mr. F. E. Courtice on January 6 (1912) and January 29 (1921), and one or two birds have been seen at Barrie every winter since 1936. One bird spent the winter of 1937-8 at the farm of Mr. J. Sutherland at Holland River where it was observed by the writer on February 20.

Lawrence (1926) reported seeing a partial albino Robin at Barrie on September 21, 1926, and another was noted there by Dr. Brereton on June 29, 1938.

Average date of spring arrival (15 years), March 16 (Collingwood).

♀ April 25, 1888, Orillia.*
♂ May 6, 1934, Innisfil township.
♂ October 20, 1934, Wasaga Beach
♂ May 7, 1941, Severn Bridge.*

169. **Wood Thrush.** *Hylocichla mustelina.*—An uncommon spring and fall transient and summer resident; breeds. This thrush usually puts in an appearance about the second week of May, with occasional individuals arriving during the first week of that month.

Young (Macoun, 1904) describes it as locally common and breeding at Penetanguishene. It was found on Giant's Tomb Island on June 10, 1937. This species is a regular but uncommon breeding bird in well-wooded areas throughout the county. A nest and four eggs (in R.O.M.Z.), taken by Mr. H. B. Haugh at Barrie on June 14, 1918, and a set of two eggs (in R.O.M.Z.), taken by Dr. Harrington at Wasaga Beach on July 13, 1914, have been recorded by Baillie and Harrington (1937). Completed sets of eggs have been found as early as June 5 (1938) by Mr. H. P. Bingham at Little Lake. In five nests found by him from 1928 to 1940, four contained four eggs each and one had three eggs. Mr. R. D. Ussher discovered a nest with three eggs at Tea Lake on June 15, 1938. Another nest containing four small young was found by the writer on June 9, 1941, at Edward's Lake, Nottawasaga township.

Towards the latter part of August the Wood Thrush becomes scarce and difficult to find in its usual summer haunts. Fewer birds are in evidence during the fall migration than in spring. An individual observed at Wasaga Beach on October 9, 1933, is our latest autumn record.

Average date of spring arrival (9 years), May 13 (Collingwood); earliest, April 30, 1938 (Barrie).

♀ May 15, 1925, Little Lake.*

170. **Hermit Thrush.** *Hylocichla guttata.*—A fairly common spring and fall transient and an uncommon summer resident; breeds. One of the earliest thrushes to appear in spring, this species usually arrives about mid-April. The height of the migration takes place from April 20 to May 15, with a few tardy individuals being noted passing through the Holland River area as late as May 23 (1941).

It occurs chiefly as a migrant but locally-distributed pairs have been found breeding in the northern half of the county. Starr (1923) reported it rather common locally in the Georgian Bay district and found a nest containing four recently hatched young on June 8 (1923), and another with four eggs on June 12 (1923). A rather late nest of four eggs (probably a second set) was found by Mr. C. E. Molony at Wasaga Beach on July 27, 1943. When shown to the writer on August 2, the eggs were just on the point of hatching; the young left the nest on August 15. Mr. H. P. Bingham collected a nest containing four eggs at Little Lake on June 21, 1934. It was built on the ground and well hidden in a mossy knoll.

The Hermit Thrush migrates somewhat later in the fall than other members of the family, the peak of the movement being reached during the first two weeks of October. Transients in gradually declining numbers are in evidence until the end of the month (latest, October 30, 1938, Wasaga Beach).

Swainson and Richardson (1831) secured a specimen at Penetanguishene in April, 1825; and Bell (1861) reported another specimen taken at this point by Mr. Alexander Murray in 1860. Three specimens collected at Orillia by Dr. Walker in 1887-8 are in the R.O.M.Z.

Average date of spring arrival (14 years), April 21 (Collingwood); earliest, April 7, 1921 (Collingwood).

? July 12, 1887, Orillia.*
? August 20, 1887, Orillia.*
? April 30, 1888, Orillia.*
♀ April 25, 1935, Holland River, Bradford.
♀ October 20, 1935, Holland River, Bradford.

171. **Olive-backed Thrush.** *Hylocichla ustulata.*—A fairly common spring and fall transient and uncommon summer resident in northern sections of the county. This thrush usually arrives about the third week of May, with peak numbers occurring between May 20 and 26. Mr. J. L. Baillie observed three late migrants at Wasaga Beach on June 3, 1938. While no positive evidence of nesting is available at the present time, its occurrence during the breeding season suggests that it may nest sparingly. One was noted at Penetanguishene, June 11-15, 1935, by the R.O.M.Z. survey party; and Mr. R. D. Ussher and the writer found it at Tea Lake, June 15-17, 1938.

The fall migration takes place during September and the first half of October. Six individuals were encountered at Marl Lake on September 7, 1942; and two at Big Cedar Point on September 20, 1942. An early migrant was found by Mr. E. R. Hunter at DeGrassi Point on August 22, 1933. Our latest autumn date is October 13, 1941, when four were noted at Holland River.

Average date of spring arrival (5 years), May 20 (Barrie); earliest, May 17, 1925 (Little Lake).

2 ? ? May 17, 1925, Little Lake.*
♂ May 22, 1932, Minesing Swamp.
♂ August 22, 1933, DeGrassi Point.*
♀ May 24, 1939, Holland River, Bradford.

172. **Grey-cheeked Thrush.** *Hylocichla minima.*—An uncommon spring and fall transient. The paucity of records for this thrush in the county is probably due to its rather retiring nature and to some confusion with the preceding species. Mr. S. H. Henry reported observing it at Collingwood, May 20, 1915, and May 20, 1916. One bird was noted at Minesing Swamp on May 22, 1932, by several members of the Brodie Club of Toronto; and another was identified at Barrie by Dr. E. L. Brereton on May 20, 1944. An individual observed at Oakview pine barrens by Mr. J. L. Baillie and Dr. F. A. E. Starr on June 2, 1929, marks its latest spring occurrence.

Southbound migrants move through the county during September and early October. At Oro Station Mr. D. S. Miller observed two birds on September 22, 1941, and two on September 23. Dr. Brereton saw a single bird at Wasaga Beach on September 27, 1941. In 1942 four individuals were seen and a specimen secured at Holland River on September 12; and at Big Cedar Point one bird was seen on September 20. A single bird noted by the writer on October 3, 1943, at the Holland River is our latest fall record for this species.

♂ September 12, 1942, Holland River, Bradford.

173. **Wilson's Thrush.** *Hylocichla fuscescens.*—A fairly common spring and fall transient and summer resident; breeds. In spring this thrush can be looked for during the first half of May. Individuals have been noted at Barrie as early as April 25 (1941) by Dr. Brereton, and Mr. W. W. Smith has found it at Big Cedar Point on April 27 (1941). Maximum numbers occur between May 15 and 25.

It is a fairly common breeding bird in moist or swampy woodlands throughout the county, somewhat less numerous in northern townships. It was noted on Giant's Tomb Island, June 11, 1937; Buckskin Lake, Matchedash township, on June 17, 1938; and at Severn Bridge on June 21, 1939.

Young (Macoun, 1904) reported it as a breeding summer resident at Penetanguishene. Baillie and Harrington (1937) have recorded taking a set of four eggs at Minesing on June 4, 1929, and a nest with three eggs (in R.O.M.Z.) taken at Little Lake on July 3, 1918, by Mr. H. B. Haugh. Nests with full complements of four eggs have been found as early as June 2 (1940) by Mr. W. W. Smith at Big Cedar Point, where it is locally common. A nest with four eggs was discovered near Barrie by Dr. Brereton on June 4, 1939. It contained four recently hatched young on June 17. Young, just out of the nest, being fed by adults were noted at Holland River on June 23, 1930, by Mr. R. A. Smith.

This is one of the first thrushes to depart for the south, many leaving in late August. By September 1, it has become relatively scarce. An individual noted at the Holland River on September 7, 1941, is our latest autumn record.

Average date of spring arrival (8 years), May 10 (Barrie).

? May 16, 1925, Little Lake.*
♀ June 13, 1935, Penetanguishene.*
♀ August 22, 1936, Holland River, Bradford.

174. **Red-breasted Bluebird.** *Sialia sialis.*—A common spring and fall transient and fairly common summer resident; breeds. The first recorded reference to this species is that given by Head (1829) who tells of shooting one at Kempenfelt Bay on June 1 [1815]. Swainson and Richardson (1831) recorded a specimen taken at Penetanguishene in April, 1825. Young (Macoun, 1904) reported it as "very abundant" at Penetanguishene in the spring of 1903.

Among our earliest spring arrivals, the Red-breasted Bluebird usually appears about the last week of March along with the Robin, Red-winged Blackbird and Crow Blackbird. The peak of the movement occurs between March 26 and April 22. A migrating flock numbering 294 birds was encountered at Lefroy by Mr. Reginald James on March 28, 1943.

This well-distributed species breeds in suitable cavities in fence-posts and tree stubs throughout the county. It is one of the first birds to nest in the spring, a completed set of five eggs having been found as early as April 27 (1941) at Big Cedar Point by Mr. W. W. Smith; and Mr. H. P. Bingham collected a set of four eggs at Barrie on April 29 (1938). Baillie and Harrington (1937) recorded it nesting at Barrie (set of four eggs, May 5, 1915) and Wasaga Beach (set of three eggs, June 21, 1924). The earliest date for young birds is May 24 (1939), when a nest with two recently hatched young and two eggs was found at Glenview Beach, Innisfil township, by Mr. G. Lambert. At North River, Matchedash township, a nest containing three small young and one egg was found on June 12, 1938. Four half-grown young in a fence-post cavity were examined at Bradford on June 5 (1938). Mr. R. D. Ussher and the writer saw young on the wing as early as June 16 (1938) at Tea Lake, and a family group consisting of adults and four flying young was noted at DeGrassi Point on June 20, 1941.

The southward migration takes place from the last week of September to the first half of October. Flocks containing upwards of 25 individuals have been noted during this period. Five birds observed near Cranberry Lake on October 17, 1937, constitute our latest autumn record.

Average date of spring arrival (8 years), March 28 (Collingwood); earliest, March 11, 1921 (Collingwood).

♂ August 23, 1887, Orillia.*
♂ April 23, 1888, Orillia.*
? May 4, 1925, Little Lake.*
♀ May 6, 1934, Innisfil township.
♂ May 16, 1931, Minesing.

175. **Golden-crowned Kinglet.** *Regulus satrapa.*—A common spring and fall transient; uncommon winter visitant, and rather rare summer resident; breeds. The spring migration takes place during the last three weeks of April. A marked decline in numbers is to be noted after May 1. In the fall the southward migration is under way during the last week of September and continues throughout October. Migrants decrease rapidly in numbers thereafter and relatively few are noted in the winter months.

During the summer it has been found occasionally frequenting stands of black spruce in which it is known to nest. Owing to its diminutive size, this species is doubtlessly often overlooked and is probably more numerous than is generally supposed. A recently completed, but empty, nest (in R.O.M.Z.) was found 25 feet up in a black spruce by Dr. Harrington on June 8, 1929, at Wasaga Beach (Baillie and Harrington, 1937). Several pairs were found at Holland River during the summer of 1939; and Ussher (1939) found it nesting on the southern border of the Holland River Marsh (King township) on June 12, 1937.

Average date of spring arrival (12 years), April 18 (Collingwood).

♂ October 20, 1934, Beeton.
♂ April 25, 1935, Holland River, Bradford.

176. **Ruby-crowned Kinglet.** *Corthylio calendula.*—A common spring and fall transient. The first spring migrants appear about mid-April, with the period of maximum abundance occurring between April 25 and May 10. Northbound transients in gradually decreasing numbers pass through the region until about May 25.

The observation of a singing male at Wasaga Beach on June 2, 1929, by Messrs. Baillie and Harrington points to the likelihood of this species being a rare local summer resident in the county.

Autumn transients have been noted at Holland River as early as September 10 (1939), and the peak of the southward movement takes place from about October 4 to 17. A single belated individual noted at Wasaga Beach on November 11, 1934, is our latest fall record.

Average date of spring arrival (12 years), April 24 (Collingwood); earliest, April 15, 1938 (Holland River).

♂ October 15, 1936, Wasaga Beach.

177. **American Pipit.** *Anthus spinoletta.*—An uncommon spring and common fall transient. This species usually appears during the first two weeks of May, but the number of individuals is small compared with the large flocks which pass through the region in the fall. Mr. R. J. Rutter reported observing a flock of 25 birds at Minesing on May 17, 1931. Northbound transients have practically all moved on by May 20. During its semi-annual visits the American Pipit frequents more open situations such as fields and stony beaches.

Southbound migrants have been noted as early as September 5 (1937), at Wasaga Beach, but the largest flights pass through from October 1 to 22. Messrs. Baillie and Harrington recorded 273 birds at Wasaga Beach on October 2, 1927, and Mr. D. S. Miller and the writer noted 80 individuals on the marsh garden plots at Holland River on October 22, 1940.

Average date of spring arrival (5 years), May 6 (Barrie); earliest, April 18, 1942 (Barrie).

? October 12, 1924, Wasaga Beach.*
♂ October 1, 1927, Wasaga Beach.*
♀ October 17, 1937, Wasaga Beach.

178. **Bohemian Waxwing.** *Bombycilla garrula.*—A casual winter visitant. This beautiful visitor from the northwest has been recorded on a few occasions. Mr. S. H. Henry reported observing five birds on February 3, 1915, at Collingwood, where they were seen daily during the remainder of the month. On December 23, 1937, Dr. Brereton discovered a flock of 14 birds feeding on dried berries of a mountain ash tree in Barrie. Although most of this flock soon departed, three individuals remained and were seen almost daily by many observers, including the writer, until January 24 (1938).

Three Bohemian Waxwings were detected in a flock of 25 Cedar Waxwings by Mr. W. W. Gunn on December 14, 1939, on Niagara Street, Collingwood. They were observed to be feeding on mountain ash berries, old apples and frozen grapes. Major Mark Robinson and Dr. Brereton encountered a flock of 17 individuals at Barrie on November 22, 1941.

179. **Cedar Waxwing.** *Bombycilla cedrorum.*—A common spring and fall transient and summer resident; uncommon winter visitant; breeds. While this species is present in varying numbers throughout

the year, a marked influx of migrants is to be noted in late May and early June.

In summer it is a common and well-distributed breeding bird, having a preference for nesting sites in the vicinity of water. The Cedar Waxwing is a rather late breeder and nest building is seldom under way before the second week of June (June 13, 1939, Anten Mills). Mr. W. W. Smith found a completed set of four eggs on June 15 (1940) at Big Cedar Point. At Tea Lake, a set of three eggs was found by the writer on June 16 (1938) and a set of four eggs located at Severn Falls on June 17 (1938). The latest date for fresh eggs is July 31 (1914), set of four eggs at Wasaga Beach by Dr. Harrington. Young (Macoun, 1904) reported it to be "a common breeding summer resident at Penetanguishene." Harrington (1915) records having found 22 nests of this species in 1914 and 1915, at Wasaga Beach. A set of four eggs taken at Barrie by Mr. H. P. Bingham on June 24, 1922, is in the R.O.M.Z. Young birds in the nest have been found from July 5 (1922), at Wasaga Beach by Dr. Harrington, to as late as August 30 (1941), when Dr. Brereton saw a nest with three young at Little Lake. Young, out of the nest, being fed by parents, were noted at Wasaga Beach on September 2, 1940.

The fall migration takes place in September and by October 1, the species has become relatively scarce. In winter, flocks of these birds wander erratically about the county stopping where food is available. Melville (1892) states that two birds were present at Orillia from December, 1890 to January, 1891. Mr. S. H. Henry observed a flock of 60 at Collingwood on February 20, 1915. Dr. Brereton reported them to be unusually plentiful at Barrie during the winter of 1939-40, when flocks of upwards to 60 birds were seen during December, January and February. A flock of 12 was observed there by the writer on February 20, 1941.

? July 14, 1887, Orillia.*
? May 12, 1925, Little Lake.*
♂ June 17, 1935, Otter Lake.
♂ May 30, 1938, Barrie.

180. **Northern Shrike.** *Lanius borealis.*—An uncommon winter visitant. This species arrives from the north about the first of November (earliest, October 31, 1937, Holland River). It is noted rather irregularly during the winter months, the number seen varying considerably from one year to the next. During its stay in the region it frequents bushy edges of woods and marshes, where it sits sentinel-like in the top of a tree watching for mice and small birds upon which it feeds. It is also to be observed at the outskirts of towns where it preys largely upon English Sparrows.

During the winter of 1938-39 it was more plentiful than usual, as many as three individuals having been seen in one day (February 25) at Barrie by Dr. Brereton. Two birds were noted near Little Lake by Messrs. D. S. Miller, F. Barratt, and the writer on January 8, 1939. It generally moves northward in March. Swainson and Richardson (1831) record having taken a specimen at Penetanguishene in 1825, and Young (Macoun, 1904) considered it "an occasional winter visitant." A specimen collected at Little Lake on December 2, 1920, by Mr. H. B. Haugh is in the R.O.M.Z.

? December 2, 1920, Little Lake.*

181. **Common Shrike.** *Lanius ludovicianus.*—A fairly common transient and summer resident; breeds. In spring this species usually appears in early April and occasionally during the last week of March. It frequently is found perched on telephone wires along highways, especially less travelled sideroads having hawthorn trees scattered along the fences.

As a breeding bird it is well distributed over the county, being somewhat more common in southern townships. In some cases nesting duties are commenced in April, a nest containing one egg having been found 15 feet up in a white spruce as early as April 28 (1935) at Bradford by Mr. R. A. Smith. This nest contained five heavily incubated eggs on May 13 (Baillie and Harrington, 1937). The rather late date of July 9 (1917), for a set of four eggs (in R.O.M.Z.) taken at Barrie by Mr. H. P. Bingham, suggests that occasionally a second clutch is laid by this species.

Young in the nest have been found as early as May 21 (1933) at Big Cedar Point by Mr. J. J. Baker; and another nest, 12 feet up in a white elm, containing four recently hatched young and one egg was found there by the writer on June 1, 1941. Four young flew from a nest in a hawthorn at Holland River on June 5 (1938) when approached too closely. A late brood of four young, attended by parents, was seen by Mr. Rodger Stanfield on August 15, 1936, at Martyrs' Shrine, near Midland (Baillie and Harrington, 1937).

The Common Shrike departs for the south in August and by September 1 only a few late stragglers remain. An individual noted at Midhurst on September 3, 1938, is our latest autumn record.

Average date of spring arrival (7 years), April 9 (Collingwood); earliest, March 26, 1916, Collingwood.

♂ May 29, 1930, Hawkestone.*
♀ May 29, 1930, Hawkestone.*
♂ September 2, 1935, Bradford.

182. **Starling.** *Sturnus vulgaris.*—An abundant transient and resident; breeds. The introduced European Starling, which invaded Ontario by way of New York State in 1919 (Lewis, 1927), did not reach Simcoe County until 1921, when it was first noted at Barrie by Dr. Brereton who thus described his observation in the Barrie *Examiner* of March 26, 1936: "Locally, . . . the first Starling observed in the county of Simcoe or even north of Toronto was seen by the writer on Bradford Street [Barrie] February 12, 1921. The bird was flying and in my first glimpse of it I decided that it was either a Rusty Blackbird or some member of the grackle family. Immediately afterwards I noticed the abbreviated tail and different wing motion. . . . A few days later, I found my bird again in a tree in the gully south of the Agricultural Park. This time it was whistling and using notes I had never heard before. This bird soon disappeared and for two years no more were seen. Then two or three appeared at Barrie and from that time on they gradually increased." Early records of the bird's penetration into the county are here set forth. By May, 1925, the Starling had reached and nested at Orillia (Lewis, loc. cit.). Mr. H. B. Haugh noted it at Little Lake during the summer of 1926. On June 2, 1927, Mr. L. Campbell found the first set of five eggs (now in the Bingham collection) in a cavity in a telephone pole at Camp Borden. The first indication that the species had reached the vicinity of Georgian Bay was on July 1, 1927, when several were observed by the writer near Marl Lake. Baillie (1928) recorded that Mr. Allan Twining had observed a flock, estimated to contain 500 birds, going to roost in the marsh at Orr Lake about September 1, 1927. A nesting cavity containing young, ten feet up in a maple, was found by Baillie and Harrington at Jack's Lake on June 4, 1928; and a set of four eggs was collected by Mr. H. P. Bingham in Vespra township, near Barrie, on June 1, 1929.

After 20 years, the Starling is an abundant breeding bird throughout the county, with an annual nesting population that now appears to be fairly constant. However, this is not the case with the transient flocks, which seem to be on the increase. The winter population consisting of flocks of 10 to 100 birds is to be found chiefly in the vicinity of towns and villages. About the last week of March, a marked influx of migrants is apparent. By May 1 the transient flocks have passed on and local breeding pairs are preparing to nest. Fresh eggs have been found from May 7 (when a nest of five was noted at Barrie by Mr. D. Butler in 1938) to June 21 (when a nest with two eggs was observed at Collingwood by the writer in 1935). Young in the nest have been found as early as May 24 (1939), in Innisfil township, where

Mr. G. Lambert examined a nest containing five young and two eggs. Young of the year on the wing have been seen at the Holland River as early as June 5 (1938).

In early July they congregate in steadily increasing flocks which reach enormous numbers later in the month. On July 16, 1938, Dr. Brereton and the writer watched great flocks, which must have totalled close to 5000 birds, going to roost for the night in willows along the southern end of Kempenfelt Bay. Near Alliston a flock estimated to contain 1000 individuals was seen on July 15, 1939; and Mr. C. E. Molony and the writer observed a flock of between 2000 and 3000 birds near Collingwood on September 6, 1937. A steady decrease is evident after October 1.

From an economic standpoint, the Starling is probably mainly beneficial in that it destroys large numbers of cutworms, grasshoppers and other harmful insects. Some cherries may be eaten in season but the bird's value as a pest destroyer far outweighs its destructiveness to the fruit farmer. One of the chief objections raised against this bird is its habit of usurping nesting-cavities formerly occupied by such beneficial species as bluebirds, tree swallows and woodpeckers. In its disfavour, also, is the unsightly damage caused to shade trees when used as roosting places by large flocks of these birds.

♂ March 31, 1935, Wasaga Beach.

183. **Yellow-throated Vireo.** *Vireo flavifrons.*—A rare spring and fall transient and a probable summer resident. Four records are available for this species. A male specimen taken at Minesing by Mr. C. E. Hope on May 17, 1931, is in the writer's collection. In the same locality on May 22, 1932, two individuals were noted in song by Mr. J. L. Baillie, and Dr. C. H. D. Clarke collected a male which is now in the R.O.M.Z. Two sight records by the writer complete its present known history in the region; one bird observed at Batteaux Creek, Collingwood, on September 6, 1937, and another at the Holland River on August 27, 1938.

♂ May 17, 1931, Minesing. ♂ May 22, 1932, Minesing.*

184. **Solitary Vireo.** *Vireo solitarius.*—An uncommon spring and fall transient. This is the earliest vireo to return in the spring and migrants are in evidence from the first week of May until, at least, May 24 (1937), the latest date it has been noted at Wasaga Beach. Mr. S. H. Henry reported it as early as May 2 (1916), at Collingwood, and Dr. Brereton has found it at Barrie on May 7 (1938). A male specimen taken near Stroud, Innisfil township, on May 6, 1934, by

Mr. S. C. Downing is in the writer's collection. Mr. R. A. Smith collected a male at Holland River on May 13, 1935.

Evidence that this species may occasionally summer in northern sections of the county was demonstrated by Mr. C. E. Hope when he took a male (in R.O.M.Z.) at Penetanguishene on June 14, 1935.

Fall migrants have been noted at Wasaga Beach on September 4 (1938); Holland River, September 11 (1938, Gunn); Oro Station, September 22 (1941, Miller) and Barrie, September 24 (1938, Brereton). At Big Cedar Point on September 20, 1942, the writer encountered four birds, several of which were singing. An individual observed at Wasaga Beach on October 9, 1933, is our latest autumn record.

Average date of spring arrival (6 years), May 16 (Barrie); earliest, May 2, 1916 (Collingwood).

♂ May 6, 1934, Stroud, Innisfil township. ♂ June 14, 1935, Penetanguishene.*

185. **Red-eyed Vireo.** *Vireo olivaceus.*—A very common spring and fall transient and summer resident; breeds. The first early spring migrants usually appear about mid-May and by May 21, it has become well established.

This species is one of the commonest and most evenly distributed breeding birds in the county. It frequents both mature and second-growth mixed forests. Mr. D. Scott and the writer found it to be one of the commonest birds on Giant's Tomb Island, June 10-11, 1937. In the Tea Lake-Severn Falls area it was particularly numerous, June 12-18, 1938. Young (Macoun, 1904) reported it to be a common summer resident at Penetanguishene. Dates for nests with fresh eggs range from June 6 (set of three eggs found at Wasaga Beach by Dr. Harrington in 1919) to July 17 (set of three eggs, in R.O.M.Z., taken at Little Lake by Mr. H. B. Haugh in 1918) (Baillie and Harrington, 1937). A nest containing one recently hatched young and three eggs was found on June 23, 1940, by Mr. R. A. Smith at Holland River.

The Red-eyed Vireo is commonly and sometimes copiously parasitized by the Cowbird in this region. Near Barrie Mr. H. P. Bingham found a nest of this species containing one egg of the host and six Cowbird's eggs, and, further, a broken vireo's egg was noted beneath the nest. On June 29, 1941, a nest with one young vireo and a Cowbird's egg was found at Wasaga Beach. At DeGrassi Point one was seen feeding a young Cowbird on July 17, 1936, by Messrs. E. M. Walker and E. R. Hunter (Baillie and Harrington, 1937); and at Wasaga Beach an adult was observed feeding a full-grown young Cowbird as late as September 2 (1940).

The fall migration takes place in late August and during the first half of September. An individual observed at Oro Station by Mr. D. S. Miller on September 22, 1941, constitutes our latest autumn record.

Average date of spring arrival (15 years), May 21 (Collingwood); earliest, May 14, 1915 (Collingwood).

? July 15, 1887, Orillia.*
? September 1, 1887, Orillia.*
♂ May 28, 1930, Little Lake.*
♂ May 25, 1932, Little Lake.*
♀ August 16, 1936, Wasaga Beach.

186. **Philadelphia Vireo.** *Vireo philadelphicus.*—An uncommon spring and fall transient. This vireo appears about the same time as the Red-eyed Vireo, but compared to that species is relatively scarce. Spring migration dates range from May 16 to May 24. Autumn occurrences fall between August 27 (one recorded at Wasaga Beach in 1942) and September 28 (an individual noted at Barrie by Dr. Brereton in 1940).

Average date of spring arrival (3 years), May 22 (Wasaga Beach).

♂ May 21, 1938, Holland River, Bradford.
♂ September 2, 1940, Collingwood.

187. **Warbling Vireo.** *Vireo gilvus.*—An uncommon transient and fairly common summer resident; breeds. The first wave of spring migrants usually arrives about the second week of May and by May 20, the species has become fairly common in its accustomed summer haunts. It appears to have a marked preference for rows of shade trees in towns and villages and few communities in the county are without at least one pair of these birds. On June 11, 1940, singing males were recorded by the writer in the towns of Barrie, Orillia, Fesserton, Waubaushene and Victoria Harbour. Other localities where it is a regular summer resident, include DeGrassi Point, Penetanguishene, Wasaga Beach, Severn Bridge, Washago, Stayner, Nottawa and Collingwood.

The finding of a nest at Cookstown by Mr. M. W. Curtis has been recorded by Baillie and Harrington (1937). Mr. J. J. Baker has found it nesting (set of three eggs) as early as May 21 (1933) at Big Cedar Point, where also a nest of four eggs, 25 feet up in a maple, was found by the writer on June 13, 1943. Mr. H. P. Bingham collected a set of four eggs at Little Lake on June 14, 1928.

When in song, the Warbling Vireo is readily identified, but after it has stopped singing, in late summer (latest, August 18, 1940, Wasaga Beach), it is rarely detected and exact departure dates are indeterminable.

Two specimens taken by Mr. C. E. Hope and listed below are in the writer's collection.

Average date of spring arrival (7 years), May 19 (Barrie); earliest, May 3, 1942 (Big Cedar Point).

♂ May 17, 1931, Minesing. ♀ May 17, 1931, Minesing

188. **Black and White Warbler.** *Mniotilta varia.*—A common spring and fall transient and a fairly common summer resident; breeds. This is one of the first warblers to appear in the spring, early birds usually arriving during the first week of May. Maximum numbers, however, occur from about May 12 to May 20.

In summer it is generally distributed, breeding in suitable woods throughout the county. Mr. A. D. Henderson collected a set of five eggs near Little Lake on June 5, 1897. Mr. D. Scott and the writer found this species established as a fairly common summer resident on Giant's Tomb Island, June 10-11, 1937. It was observed regularly at Severn Falls, Tea and Buckskin Lakes, from June 13 to 18, 1938, and at Penetanguishene Lake, Hogg's Bay and Waubaushene, June 14-16, 1939. Dr. Brereton and the writer found it at Severn Bridge, Wasdell Falls and Grass Lake on June 21, 1939. A set of four eggs taken at Barrie on June 10, 1923, by Mr. H. P. Bingham, and a nest containing three eggs plus a Cowbird's egg, found by the writer at Wasaga Beach on June 20, 1934, have been recorded by Baillie and Harrington (1937). In this latter nest the young hatched on June 24. Young, out of the nest, being fed by parents were observed at Big Cedar Point as early as June 19 (1941). Family groups have been noted at Glenwood Beach, Innisfil township, by Mr. G. Lambert on July 19, 1939, and at Holland River by the writer on July 1 (1936); July 30 (1939); and July 7 (1940—R. A. Smith).

The southward movement begins early in August (Dr. Brereton recorded 20 birds, Wasaga to Balm Beach on August 18, 1941) and migrants pass through the county until the third week of September (latest, September 22, 1935, Wasaga Beach).

Average date of spring arrival (8 years), May 6 (Barrie); earliest, April 30, 1938 (Barrie).

? August 6, 1887, Orillia.* ♀ September 1, 1935, Wasaga Beach.

Hypothetical.

Prothonotary Warbler. *Protonotaria citrea.*—One was recorded by Dr. E. L. Brereton at Willow Creek, 4th concession of Vespra township, on May 15, 1930. In view of its rarity so far north and pending additional supporting evidence it has been thought best to consider this species as hypothetical for the present.

189. **Golden-winged Warbler.** *Vermivora chrysoptera.*—A rare transient and very rare summer resident. This species has been observed during migration by Dr. Brereton at Little Lake on May 16 (1939); May 2 (1942); and August 30 (1941). These dates are the only indication of its semi-annual movements through the region. A male specimen taken on May 16, 1939, by Dr. Brereton is in the writer's collection. There are two summer records; a single individual was seen at Collingwood on June 11, 1929, by Dr. P. Harrington and Dr. F. Starr (Baillie and Harrington, 1937); and on June 18, 1938, a singing male was found by Mr. R. D. Ussher, Dr. Brereton and the writer in an alder-bordered slough, five miles south of Severn Falls. No nesting evidence exists for the species in the county.

♂ May 16, 1939, Little Lake.

Hypothetical.

Blue-winged Warbler. *Vermivora pinus.*—The only report of this species in the county is one recorded by Dr. E. L. Brereton at Wasaga Beach on May 16, 1941. The Blue-winged Warbler, however, has yet to be taken this far north and the writer feels that, lacking a specimen for so unlikely a species, it had best be classed as hypothetical.

190. **Tennessee Warbler.** *Vermivora peregrina.*—An uncommon spring and fall transient. This warbler occurs regularly in migration, but because it usually keeps high in the tree tops is rather inconspicuous. It has been observed passing through the county between May 14 and May 24. At Little Lake, Dr. Brereton noted its arrival on May 14 (1938), and May 16 (1939), while on May 20 (1939) four individuals were seen. Singing male specimens were secured by Messrs. J. L. Baillie and C. E. Hope at Minesing on May 22, 1932, and several individuals were observed there by the writer on May 20, 1934.

A September migrant, the Tennessee Warbler has been recorded at Wasaga Beach on September 5-6 (1943); Holland River, September 10 (1938); and Big Cedar Point, September 20 (1942).

Average date of spring arrival (6 years), May 18 (Barrie).

♂ May 22, 1932, Minesing.* ♀ May 24, 1939, Holland River, Bradford,
♂ May 22, 1932, Minesing.

191. **Orange-crowned Warbler.** *Vermivora celata.*—A rather rare spring and fall transient. This species passes through the region

inconspicuously from May 16 to May 21, and again from September 11 to October 9. A male specimen collected at Minesing by Mr. T. M. Shortt on May 16, 1931, is in the R.O.M.Z., and an immature male taken at Holland River on September 11, 1937, by Mr. C. E. Hope is in the writer's collection. On October 9, 1939, two individuals were noted among small bushes bordering Collingwood harbour and a female specimen secured by the writer.

Average date of spring arrival (3 years), May 17 (Barrie); earliest, May 16, 1931 (Minesing).

♂ May 16, 1931, Minesing *
Imm. ♂ September 11, 1937, Holland River, Bradford.
♀ October 9, 1939, Collingwood.

192. **Nashville Warbler.** *Vermivora ruficapilla.*—A common spring and fall transient and fairly common summer resident; breeds. Although this species usually arrives about the first week of May, it has been noted as early as April 30 on two occasions; at Wasaga Beach in 1933 and at Little Lake in 1938. The number observed increases markedly during the period from May 8 to May 20, when as many as 20 individuals have been noted in a day (May 16, 1939, Little Lake-Brereton).

In the breeding season it is a regular inhabitant of suitable spruce and tamarack swamps, particularly those in which sphagnum moss is present. Starr (1923) reported it as "rather common" in the Georgian Bay district. A nest containing three eggs, plus two Cowbird's eggs, was found on June 7, 1929, at Orr Lake by Baillie and Harrington (1937). It was placed on the ground in sphagnum moss at the base of a black spruce. A set of five eggs taken by Mr. H. P. Bingham on May 26, 1922, at Little Lake, is in the R.O.M.Z. At Holland River, where it is a locally common summer resident, an agitated pair carrying food was observed by the writer on July 3, 1938, although the young were not located. Dr. Brereton noted adults similarly engaged at Little Lake on June 23, 1940. Mr. D. Scott and the writer found it to be one of the commoner warblers in moist woods on Giant's Tomb Island on June 11, 1937. Among the localities where it has been observed under conditions which suggest breeding are the following,—Penetanguishene—found to be not uncommon by the R.O.M.Z. field party, June 11-15, 1935; Buckskin Lake—three individuals noted June 17, 1938; Severn Bridge, June 21, 1939; Cranberry Lake, June 23, 1939; Springwater Park, Midhurst—two singing males, June 8, 1941; Edward's Lake, June 9, 1941; and Severn Falls—three singing males, June 12, 1941.

The southward migration occurs from late August until about the end of September, with the peak of the movement taking place from September 15 to 24; at least 15 individuals were seen at Wasaga Beach on September 20 (1941), and Messrs. D. S. Miller and G. Giles saw six birds at Oro Station on September 23 (1941). An occasional individual lingers into October (latest, October 16, 1936, Wasaga Beach).

Average date of spring arrival (8 years), May 8 (Barrie).

? May 10, 1925, Little Lake.*
? May 17, 1925, Little Lake.*
♀ September 20, 1941, Wasaga Beach.
♂ May 18, 1944, Holland River, Bradford.

193. **Parula Warbler.** *Compsothlypis americana.*—An uncommon spring and fall transient and very rare summer resident. The first Parula Warblers usually arrive about the second week of May. A specimen (in R.O.M.Z.) taken at Orillia by Dr. Walker on May 6, 1888, constitutes our earliest spring record. An increase in numbers is evident from about May 12 to May 22, after which only stragglers are observed (latest, May 26, 1935, Wasaga Beach).

There is one summer record of a singing male observed by Mr. R. D. Ussher, Dr. Brereton and the writer near Severn Falls on June 18, 1938.

Southbound migrants have been noted as early as August 21 (three birds at Wasaga Beach in 1938), and the height of the movement takes place during the first week of September. Our latest autumn record is that of two individuals seen at Holland River on September 13, 1942.

Average date of spring arrival (5 years), May 15 (Collingwood).

♂ May 6, 1888, Orillia.*
♂ September 6, 1937, Collingwood.

194. **Yellow Warbler.** *Dendroica aestiva.*—A very common transient and summer resident; breeds. Early arrivals are usually in evidence about the first week of May, and by May 20 the species has become generally common.

In the breeding season the Yellow Warbler is well distributed, being somewhat more common in the southern half of the county. Its choice of habitat varies considerably from garden shrubbery to the bushy growths along the banks of streams. Nesting activities are commenced soon after arrival and a nearly completed nest was found as early as May 18 (1941) at Big Cedar Point, where it is locally abundant. Six nests, containing from one to four eggs each, were observed in this locality by Mr. W. W. Smith and the writer on June 1, 1941. Baillie and Harrington (1937) record the finding of a nest (in R.O.M.Z.) at Marl Lake on June 11, 1927, in which were embedded three Cowbird's eggs in addition to four warbler's eggs. The earliest record of a full clutch of eggs (four) was established on May 24 (1942) by Mr. W. W. Smith at Big Cedar Point. Mr. A. F. Young (Macoun, 1904) says of this species: "Abundant summer resident, breeds in gardens very frequently at Penetanguishene; I have seen four nests of this species in a garden of less than half an acre." Localities where nests and eggs have been observed include Thunder Bay (June 9, 1937); Bradford (June 12, 1938); Waubaushene (June 15, 1939); and Fesserton (June 16, 1939). Young in the nest have been found as early as June 11 (1939, three young) by Mr. R. A. Smith at Holland River; while at Big Cedar Point three large young, about ready to fly, were observed on June 19 (1941).

This is one of the first warblers to depart for the south, many birds leaving in July, and by early August the species has become noticeably scarce. Our latest record is a singing male observed on August 18, 1940, at Wasaga Beach.

Average date of spring arrival (11 years), May 8 (Collingwood); earliest, April 25, 1938 (Barrie).

♀ August 8, 1887, Orillia.*
♀ May 15, 1888, Orillia.*
♀ May 12, 1925, Little Lake.*
♂ May 26, 1930, Little Lake.*
♂ May 18, 1944, Holland River, Bradford.

195. **Magnolia Warbler.** *Dendroica magnolia.*—A common spring and fall transient and fairly common summer resident; breeds. This species usually appears about the middle of May, reaching its maximum numbers between May 16 and 26. By the end of the first week of June, all except the local breeding population have moved northward.

In summer its distribution is controlled to a large extent by the existence of suitable stands of coniferous woods, particularly those of black spruce-balsam type. It is uncommon south of Barrie, but north of that place it is met with fairly commonly as a breeding bird. Starr (1923) recorded the finding of a nest containing four fresh eggs on June 12 (1923), at Wasaga Beach, and a nest with three eggs plus a Cowbird's egg was located there by Dr. Harrington on June 11, 1927. At Severn Falls a nest containing three recently hatched young in addition to a young Cowbird was found by the writer on June 12, 1941. The nest was placed four feet up in a small balsam fir. Besides the aforementioned records, it has been observed in the month of June at the Holland River, Big Cedar Point, Cranberry Lake, Penetanguishene, Wasdell Falls and Tea Lake under conditions which suggest probable additional breeding localities.

The southward migration is under way in late August and continues throughout September with an occasional straggler lingering into October (latest, October 11, 1941, Barrie).

Average date of spring arrival (15 years), May 17 (Collingwood); earliest, April 30, 1938 (Little Lake).

♀ May 21, 1932, Minesing.
♂ May 17, 1936, Holland River, Bradford.
Imm. ♀ September 12, 1937, Holland River, Bradford.
Imm. ♂ September 14, 1937, Holland River, Bradford.

196. **Cape May Warbler.** *Dendroica tigrina.*—A fairly common spring and an uncommon fall transient. This species is of regular occurrence but its numbers fluctuate considerably from year to year. A few birds are usually noted in the first heavy warbler flight in May. In 1939, Dr. Brereton recorded it daily at Little Lake from May 15 to May 20, in numbers of from two to twelve birds. In other years only a few individuals have been observed. Spring dates range from May 9 to May 26. A specimen taken at Orillia by Dr. Walker on May 15, 1888, is in the R.O.M.Z., and a male collected at Minesing by Mr. R. J. Rutter on May 17, 1931, is in the writer's collection.

The southward migration occurs mainly during September. An immature female was taken by the writer at Holland River on September 8, 1935, and two individuals noted there on September 10, 1939. Three birds were recorded at Wasaga Beach on September 7, 1942.

Average date of spring arrival (8 years), May 17 (Collingwood); earliest, May 9, 1914 (Collingwood).

♂ May 15, 1888, Orillia.*
♂ May 17, 1931, Minesing.
Imm. ♀ September 8, 1935, Holland River, Bradford.

197. **Black-throated Blue Warbler.** *Dendroica caerulescens.*—A fairly common spring and an uncommon fall transient; a locally distributed summer resident; breeds. Spring migrants are occasionally recorded as early as the first week of May, with the peak of the movement taking place between May 15 and 24.

This species is a rather rare summer resident from Barrie northward, locally fairly common in Tiny township, on the adjacent islands of the Christian group, and on Giant's Tomb Island. On this latter island four singing males were found inhabiting wooded areas having a profusion of deciduous shrubbery on June 11, 1937. At Macey Lake it was established in dense maple-birch-poplar second growth on June

14, 1939. Young (Macoun, 1904) records it as a summer resident at Penetanguishene, and the R.O.M.Z. field party found it not uncommon there from June 11 to 15, 1935, when several specimens were collected. The only available breeding record is that of a nest containing four eggs found by Mr. H. P. Bingham on July 4, 1918, at Little Lake (Baillie and Harrington, 1937). The presence of singing males at Wasaga Beach on June 16, 1924, and at Edward's Lake on June 9, 1941, denotes additional potential breeding localities.

The fall migration takes place in late August (August 24, 1941, Holland River) and mainly during the first half of September. Our latest autumn record concerns two individuals observed on September 23, 1941, at Oro Station by Messrs. D. S. Miller and G. Giles.

Average date of spring arrival (14 years), May 15 (Collingwood); earliest, May 5, 1916 (Collingwood).

♂ July 3, 1930, Little Lake *
♂ June 13, 1935, Penetanguishene *
♀ June 13, 1935, Penetanguishene.*
♂ September 8, 1935, Holland River, Bradford.

198. **Myrtle Warbler.** *Dendroica coronata.*—A very common spring and fall transient and a fairly common summer resident from Barrie northward; breeds. With the possible exception of the Pine Warbler, this is the earliest warbler to appear in spring, arriving considerably in advance ofthe other members of the group. It is usually present by the fourth week of April and occasionally as early as the third week of that month. The peak of the movement takes place between May 2 and 15.

It is a late migrant in the fall, the period of maximum numbers being from September 23 to October 14. Two individuals seen at Holland River in an early snowstorm on October 24, 1937, constitute our latest autumn record.

In summer the Myrtle Warbler occurs sparingly from Holland River to Kempenfelt Bay but is fairly common in the northern half of the county, breeding in coniferous trees, usually white or red pine or cedar. Records of its nesting at Wasaga Beach have been published by Harrington (1915), Starr (1923) and Baillie and Harrington (1937). In the South Georgian Bay district Dr. P. Harrington has achieved remarkable success with this species, locating some 50 occupied nests since 1913. Egg dates for Wasaga Beach range from May 28 (1913, set of four) to July 17 (1914, two eggs, plus Cowbird's egg). A nest containing one egg, plus two Cowbird's eggs, taken June 2, 1940, by Dr. Harrington at Wasaga Beach is in the R.O.M.Z. At DeGrassi

Point Mr. E. R. Hunter observed an adult feeding a young Cowbird on July 17, 1936. Mr. R. D. Ussher and the writer saw three singing males at Severn Falls on June 13, and four others at Tea Lake on June 15, 1938. Other localities where it has been observed under conditions suggesting probable breeding include Black Lake (June 16, 1935); Midhurst (June 13, 1939); Penetanguishene (June 14, 1939); and Midland (June 15, 1939). In the South Georgian Bay district the Myrtle Warbler is often parasitized by the Cowbird, a fact emphasized by Friedman (1938), who stated that out of 38 nests of this species examined by Dr. Harrington near Wasaga Beach, not less than 25 contained eggs of the Cowbird.

Average date of spring arrival (20 years), May 2 (Collingwood); earliest, April 20, 1941 (Barrie).

? September 24, 1887, Orillia.*
♂ May 1, 1888, Orillia.*
? May 3, 1925, Little Lake.*
♀ May 4, 1932, Little Lake.*
♀ April 25, 1935, Bradford.
♀ October 24, 1937, Bradford.
? October 22, 1942, Barrie.

199. **Black-throated Green Warbler.** *Dendroica virens.*—A common spring and fall transient and summer resident; breeds. Early spring arrivals usually appear during the first few days of May, and from May 5 to 16, it is one of our commonest migrating warblers.

In summer this well-distributed species breeds regularly in coniferous and mixed woods throughout the county. At Big Cedar Point the writer has seen adults carrying nesting material as early as June 2 (1940). Baillie and Harrington (1937) record the taking of a set of three eggs, plus a Cowbird's egg, at Orr Lake on June 5, 1928. Dr. Harrington found a nest containing three eggs, plus Cowbird's egg, at Wasaga Beach on June 8, 1927. In 1935 a pair nested in a hemlock, 15 feet from the ground, at Holland River. Young, recently out of the nest, were noted on July 5 (1915) by Dr. Harrington at Wasaga Beach, and the writer observed young, being fed by an adult, there as late as September 5 (1937), probably a second brood. The Black-throated Green Warbler was also found to be common in June in such localities as Giant's Tomb Island, Tea Lake, Severn Falls, Sparrow Lake and Edward's Lake.

The southward migration is under way in late August and from September 10 to 20 it is one of the commonest fall warblers. An individual observed at Wasaga Beach on October 9, 1933, is our latest autumn record.

Average date of spring arrival (9 years), May 7 (Collingwood); earliest, May 1, 1941 (Barrie).

♂ May 2, 1937, Holland River, Bradford.

200. **Blackburnian Warbler.** *Dendroica fusca.*—A common spring and fall transient and a fairly common summer resident; breeds. Early spring arrivals usually appear during the second week of May, and a period of maximum numbers is evident from May 14 to 24.

This species is a fairly common summer resident in the townships of Tiny, Tay, Matchedash and North Orillia. Elsewhere in the county it is uncommon at this season and rather locally distributed in mixed or coniferous woods. Although observed during the breeding season in many sections of the county, its nest has been discovered on but one occasion. Mr. H. P. Bingham located a nest containing two eggs at Barrie on June 9, 1923 (Baillie and Harrington, 1937).

The Blackburnian Warbler was found to be not uncommon at Penetanguishene by the R.O.M.Z. survey party, June 11-15, 1935. Mr. R. A. Smith and the writer noted four singing males at Black Lake on June 18, 1935. It was among the commoner warblers observed on Giant's Tomb Island, June 10-11, 1937; and in the Severn Falls- Tea Lake area was seen regularly from June 13 to 15, 1938, by Mr. R. D. Ussher and the writer.

Southbound migrants have been observed as early as August 19 (1934) at Wasaga Beach. The peak of the movement takes place from August 23 to September 15, after which only an occasional straggler is to be seen. An individual noted at Batteaux Creek, Collingwood, on October 9, 1939, is our latest fall record.

Average date of spring arrival (9 years), May 13 (Collingwood); earliest, May 5, 1938 (Barrie).

♂ May 17, 1925, Little Lake.* ♂ June 10, 1937, Giant's Tomb Island.

201. **Chestnut-sided Warbler.** *Dendroica pensylvanica.*—A common spring transient and a fairly common fall transient; fairly common summer resident; breeds. Spring migrants have been noted as early as the first week of May, but the period of greatest numbers is from May 14 to 22.

This species is widely distributed throughout the region during the nesting season, being found in bushy pasture-land, second growth thickets and especially patches of raspberry canes. Starr (1923) has reported it as fairly common in suitable localities in the Georgian Bay district. Baillie and Harrington (1937) have recorded it as nesting at Wasaga Beach (set of two eggs, plus Cowbird's egg, June 23, 1921) and at Barrie (set of three eggs found June 18, 1916), by H. P. Bingham). At Holland River nesting pairs feeding young were observed on June 22 (1940) and July 7 (1940—Dr. R. M. Saunders). The writer has encountered this species in practically every section of the county during the breeding season,—Devil's Glen, Nottawasaga township (June 9, 1935); West Bay, Sparrow Lake (June 12, 1938); Macey Lake (June 14, 1939); Beeton (July 15, 1939); Giant's Tomb Island (June 10-11, 1939); and Port Severn (June 11, 1940).

It is among the first warblers to depart after the nesting season; southbound migrants have been noted at Wasaga Beach on August 17 (1941). The movement continues until well into September. Six individuals observed at Big Cedar Point on September 20, 1942, by members of the Toronto Ornithological Club, constitute our latest autumn record.

Average date of spring arrival (9 years), May 12 (Collingwood); earliest, May 5, 1916 (Collingwood).

♀ May 22, 1888, Orillia.*
♀ May 17, 1925, Little Lake.*
♂ May 12, 1937, Holland River, Bradford.

202. **Bay-breasted Warbler.** *Dendroica castanea.*—A common spring and fall transient. Spring migrants are usually in evidence soon after mid-May, with a few records at hand for the first part of the month. The great majority, however, pass through rather late, usually between May 19 and 25. A female taken at Little Lake on June 1 (1932) by Mr. H. B. Haugh is the latest spring occurrence.

Southbound transients have been noted as early as August 17 (1941) at Wasaga Beach, and by August 24, have become fairly common. The movement continues during September although a decrease in numbers is evident after September 15. An individual noted at Little Lake on October 16, 1938, by Dr. Brereton is our latest autumn record.

Average date of spring arrival (14 years), May 20 (Collingwood); earliest, May 9, 1938 (Barrie).

♀ June 1, 1932, Little Lake.*
♀ May 15, 1938, Wasaga Beach.

203. **Black-polled Warbler.** *Dendroica striata.*—A fairly common spring and fall transient. This is one of the latest warblers to arrive in the spring, seldom appearing in numbers before May 22. The movement continues until the end of the month, and in some years well into June. Mr. F. E. Courtice has noted it at Collingwood as late as June 12 (1917).

The first southbound migrants arrive in August (August 18, 1934, Wasaga Beach) and are to be seen in small numbers during the remainder of the month. The peak of the migration takes place during the first three weeks of September. The observation of three individuals at Oro Station on September 23, 1941, by Messrs. D. S. Miller and G. Giles is our latest autumn record. An immature male taken at Holland River by Mr. C. E. Hope, September 12, 1937, is in the writer's collection.

Average date of spring arrival (8 years), May 22 (Collingwood); earliest, May 12, 1916 (Collingwood).

♂ May 22, 1932, Minesing
♂ May 17, 1936, Holland River, Bradford.
Imm. ♂ September 12, 1937, Holland River, Bradford.
♂ May 25, 1942, Big Cedar Point.

204 **Pine Warbler.** *Dendroica pinus.*—An uncommon spring and rare fall transient and a local summer resident; breeds. The spring arrival of the Pine Warbler is early, corresponding closely with that of the Myrtle Warbler It has been noted at Barrie by Dr. Brereton as early as April 20 (1938) and at Wasaga Beach by the writer on April 30 (1933). Its habit of keeping well to the tops of the taller trees during migration renders it somewhat inconspicuous. By mid-May the vernal movement is practically completed.

In summer the Pine Warbler has a wide, though irregular, distribution due to its particular habitat requirements. In some areas where pine trees are plentiful, it may even assume the status of common. It is a fairly common breeding bird along lower Nottawasaga Bay; a set of three eggs having been taken by Dr. Harrington at Wasaga Beach on June 16, 1922 (Baillie and Harrington, 1937); and another nest also found there by Dr. Harrington on June 9, 1921, contained a young Cowbird (Friedman, 1938). At Orr Lake a pair was observed gathering nesting material as early as May 26 (1939) by Mr. W. W. Gunn. Along the Severn River in the region of Copp Bay and at Tea Lake Mr. R. D. Ussher and the writer found this species to be fairly common in mature stands of white pine, June 15-18, 1938.

The fall migration is poorly defined and the species is rarely recorded at this season. A single individual observed at Wasaga Beach on September 4, 1938, is our latest autumn occurrence.

Average date of spring arrival (5 years), May 4 (Barrie).

♀ May 17, 1931, Minesing. ♂ June 16, 1938, Tea Lake.

205. **Prairie Warbler.** *Dendroica discolor.*—A rare spring and fall transient, and a local summer resident; breeds. The Prairie Warbler is undoubtedly one of the most interesting birds of the county because of its restricted range and specific habitat requirements. Never common in migration, this species appears on its breeding grounds about the third week of May.

In summer it occupies a narrow strip of sand-dune territory, scarcely more than 200 yards in width, bordering the southern and eastern shores of Nottawasaga Bay. Common Juniper (*Juniperus communis* var. *depressa*), found growing here in profusion, is used exclusively by this bird as a nesting site. Harrington (1922) first noted the Prairie Warbler at Wasaga Beach, in the summer of 1914. On June 19, 1922, he discovered the first nest (for Canada). It was placed about one foot off the ground in a clump of juniper. In it were two young, about ready to fly, and a young Cowbird. A nest containing three eggs, plus two Cowbird's eggs, was located on June 14, 1923 (Harrington, 1924).

The writer's experience with this warbler dates back to 1919, at Wasaga Beach, at which period it was a very common inhabitant of the juniper covered sand ridges bordering the shore. An estimated 150 pairs were then occupying the three miles from Oakview to the mouth of the Nottawasaga River. Since 1920, due no doubt to the extensive building of summer cottages along the beach and the resultant encroachment upon its habitat, the Prairie Warbler population has decreased at an alarming rate, so much so in fact that in 1939 only a few scattered pairs could be found in this locality. The shore northeast of the mouth of the Nottawasaga River, however, has fewer cottages and consequently this species has been less disturbed there. A nest containing four small young, found by the writer on June 24, 1934, at Two Mile Point, Wasaga Beach, has been recorded by Baillie and Harrington (1937).

One of the most interesting results of our investigations of June, 1938, was finding this species apparently well established along the rocky banks of the Severn River. Singing males were observed from Hydro Glen, near the entrance to Sparrow Lake, down to Tea Lake, and were surprisingly common along the shores of the latter lake. Although no breeding evidence was secured, it is presumed that they were nesting in common juniper which grows abundantly in this region. The finding of a singing male on a rocky burn some five miles distant from the river, southwest of Severn Falls, on June 18, 1938, tends to indicate that the range of this species over much of the Precambrian area of northern Matchedash township coincides with the distribution of common juniper.

The southward migration which occurs largely in August and early September is poorly defined. An individual that was evidently a migrant was noted moving south along the shore of the Nottawasaga River at Wasaga Beach on August 18 (1934).

Average date of spring arrival (15 years), May 23 (Wasaga Beach); earliest, May 14, 1933 (Wasaga Beach).

♂ June 18, 1922, Wasaga Beach.*
♂ June 3, 1928, Wasaga Beach.*
♂ May 24, 1937, Wasaga Beach.

206. **Palm Warbler.** *Dendroica palmarum.*—An uncommon spring and fall transient. The first Palm Warblers usually appear about the second week of May but individuals have been seen at Barrie as early as April 27 (1938) by Dr. Brereton. Specimens collected at Orillia on May 6 and 9, 1888, by Dr. Walker and by Mr. H. B. Haugh at Little Lake on May 7, 1925, are in the R.O.M.Z. The period of maximum numbers is from May 12 to 20, and none have been reported after May 25.

In the fall it usually arrives during the second week of September; ten birds were noted at Holland River on September 12, 1937, and an immature male taken by Mr. C. E. Hope. The earliest date for autumn migrants is August 18 (1941) when one was observed at Wasaga Beach. The movement continues throughout September and during the early part of October. Late dates of fall occurrence are October 4 (1939), when two individuals were noted at Holland River by the writer, and October 11 (1939), when a single bird was seen at Barrie by Dr Brereton.

Average date of spring arrival (7 years), May 11 (Barrie).

? May 6, 1888, Orillia.*
? May 9, 1888, Orillia.*
? May 7, 1925, Little Lake.*
♀ May 12, 1937, Holland River, Bradford.
Imm. ♂ September 12, 1937, Holland River, Bradford.

207. **Oven-bird.** *Seiurus aurocapillus.*—A common spring and fall transient and summer resident; breeds. The vanguard of this familiar inhabitant of our woods reaches the latitude of Simcoe County about the second week of May. The period of maximum numbers is from May 14 to 20. A particularly heavy wave of migrants, witnessed by Dr. Brereton in the Barrie area on May 17, 1933, was estimated to contain several hundred individuals.

The Oven-bird is generally distributed throughout the county as a breeding bird. Nesting activities are commenced in late May or early June, a nearly-completed nest having been found at Holland River by Mr. D. S. Miller as early as May 29 (1938). On June 5 this nest contained five eggs in addition to a Cowbird's egg. A nest discovered at Barrie by Mr. H. P. Bingham contained one egg, plus two Cowbird's eggs, on June 3, 1928; while at Holland River the writer observed a nest of three eggs as late as July 1 (1936). Five young, about one week old, were found at Wasaga Beach on June 15, 1941; and Dr. Brereton noted a nest, with young being fed by parents, at Little Lake on June 19, 1938. Breeding records for this species have also been established at Penetanguishene (nest of five eggs found by Mr. T. M. Shortt, June 14, 1935); Cawaja Beach (nest of four eggs, plus a Cowbird's egg, taken by Mr. H. P. Bingham, June 8, 1930); Severn Falls (nest of five eggs found by the writer, June 12, 1941); and Big Cedar Point (nest of one egg, plus two Cowbird's eggs, found by Mr. W. W. Smith, June 22, 1941).

The fall migration takes place mainly during September. Messrs. D. S. Miller and G. Giles reported observing four Oven-birds at Oro Station on September 23, 1941. A specimen taken at Wasaga Beach on October 1, 1927, by Mr. J. L. Baillie is our latest autumn record.

Average date of spring arrival (8 years), May 10 (HollandRiver, Bradford); earliest, May 5, 1938 (Barrie).

? August 2, 1887, Severn River, East Branch.*
♂ June 17, 1935, Otter Lake.
♀ September 1, 1935, Wasaga Beach.

208. **Northern Water-Thrush.** *Seiurus noveboracensis.*—A fairly common spring and fall transient and summer resident; breeds. The first spring arrivals usually appear during the first week of May. By the middle of the month it has become fairly common and can be heard singing from suitable wet woods throughout the county. In the Minesing Swamp, where it is locally abundant, Mr. J. L. Baillie noted twenty singing males on May 16, 1931.

In summer this species breeds locally in dark swampy woods, but its well concealed nest is not often discovered. Baillie and Harrington (1937) have reported the finding of a nest with two young and two eggs, as well as three young Cowbird's, at Cranberry Lake on June 5, 1929, and also a set of five eggs taken at Barrie by Mr. H. P. Bingham on May 25, 1924. Mr. R. A. Smith discovered a nest containing three young and one egg in swampy woods bordering the Holland River on June 16, 1940. At Big Cedar Point where this species is a common summer resident, Mr. J. J. Baker and Mr. W. W. Smith succeeded in finding six nests. The earliest date for a nest with eggs is May 23 (1937) when one with three eggs, in addition to a Cowbird's egg, was located by Mr. Baker. In 1941 two nests were shown to the writer by Mr. W. W. Smith; one contained four eggs on June 8, and the other four eggs on June 18. Both nests were well hidden, one being placed under the roots of a tree in a swamp, and the other sunken in the side of a bank bordering a stream.

The southward migration is under way in early August and continues until the first part of September, but the species is less conspicuous at this season than in the spring. An individual noted at Holland River on September 13 (1942) constitutes our latest fall record.

Average date of spring arrival (8 years), May 6 (Barrie); earliest, April 30, 1938 (Barrie).

? August 10, 1887, Orillia *
? May 4, 1925, Little Lake *
♂ May 9, 1925, Minesing *
♂ May 17, 1925, Little Lake *
♀ May 16, 1931, Minesing *
♀ May 21, 1932, Wasaga Beach *
? May 6, 1934, Innisfil township
♂ July 26, 1936, Holland River, Bradford.

209 **Kentucky Warbler.** *Oporornis formosus.*—An accidental visitant; one record On May 8, 1943, Messrs. W. W. Smith, John Crosby, R. M. Saunders, Donald Sutherland and the writer were observing the spring migration along the northern border of the Holland River Marsh four miles southwest of Bradford when Mr. W. W. Smith succeeded in locating a Kentucky Warbler feeding on the ground under hemlocks at the edge of a swampy woods. Attention was quickly focussed on this rare southern visitor and ample opportunity was afforded those present for close study. After due course the bird was collected and proved to be a male in full spring plumage. The specimen, now in the R.O.M.Z., is the third for Ontario (Smith and Devitt, 1943)

♂ May 8, 1943, Holland River, Bradford

210 **Connecticut Warbler.** *Oporornis agilis.*—A very rare spring and fall transient. This is undoubtedly one of the rarest warblers to migrate through the region. It is extremely shy and frequents dense swampy woods and bushy tangles along the banks of streams, thus making it a difficult bird to observe.

There are two records of occurrence in spring; a singing male was observed by Mr W. W. Smith at Lefroy on June 3, 1942; and a specimen found dead by Mr. H. B. Haugh at Oro Station on May 22, 1944. Through the kindness of Mr. Haugh and the efforts of Dr. Brereton the specimen was saved and is now in the writer's collection.

In the fall southbound migrants have been noted between September 2 and 24. An individual was observed at close range in the ravine south of the Agricultural Park, Barrie, by Dr. Brereton on September 24, 1938. One was seen by the writer at the mouth of the Batteaux Creek, Collingwood, on September 2, 1940, and Mr. R. A. Smith reported one at the Holland River on September 15, 1940. Messrs. D. S. Miller and G. Giles identified a single bird at Oro Station on September 23, 1941.

♂ May 22, 1944, Oro Station.

211. **Mourning Warbler.** *Oporornis philadelphia.*—An uncommon spring and rare fall migrant, and a fairly common summer resident; breeds. This is one of the latest warblers to arrive in the spring, the earliest date being May 22 (1932), when two singing males were observed in Minesing Swamp by Mr. J. L. Baillie.

In summer this species is fairly common, though somewhat locally distributed, in wooded pasture-land, forest clearings and along the bushy edges of swamps. A set of two eggs, plus a Cowbird's egg, taken at Minesing on June 9, 1929, and a nest containing four young found at Wasaga Beach on June 12, 1922, have been recorded by Baillie and Harrington (1937). Other localities where this warbler has been observed during the breeding season include Penetanguishene (two individuals observed by the R.O.M.Z. field party, June 11-15, 1935); Giant's Tomb Island (singing male noted by Mr. D. Scott, June 11, 1937); Severn Falls (three individuals noted by Mr. R. D. Ussher and the writer, June 18, 1938); Beeton Swamp (two individuals noted July 15, 1940); Holland River (singing male, June 16, 1940); and Marl Lake (two singing males, June 17, 1941).

A specimen found dead at DeGrassi Point by Mr. E. R. Hunter on August 18, 1940, probably represents an early fall migration date. Our latest autumn date is September 13, 1942, when one was observed at the Holland River by Mr. J. L. Baillie.

Average date of spring arrival (6 years), May 23 (Barrie).

♂ June 18, 1938, Severn Falls. ♀ May 24, 1943, Barrie.
Imm. ? August 18, 1940, De Grassi Point.*

212. **Maryland Yellow-throat.** *Geothlypis trichas.*—A common spring and fall transient and summer resident; breeds. One of our commonest breeding warblers, the Maryland Yellow-throat usually arrives back from the south about the second week of May. The migratory movement continues to the end of the month. Atkinson (1892) records the taking of a male specimen at Orillia on May 25, 1890.

In summer it is widely distributed over the county, preferring low shrubbery bordering marshes and streams or cut-over areas having an abundance of undergrowth. Its breeding at Wasaga Beach has been reported by Starr (1923), set of four eggs, June 15, 1923; and by Baillie and Harrington (1937), set of five eggs, June 9, 1921. The earliest date for a completed set of eggs is June 4, a nest of four eggs having been found at Little Lake by Mr. H. P. Bingham in 1940. Mr. D. Scott located a nest containing four eggs at Wasaga Beach on June 12, 1937; and a set of five eggs was found at Big Cedar Point by Mr. W. W.

Smith on June 12, 1938. Along the Holland River, where it is a common summer resident, a nest containing four young, which flew when approached, was found by Mr. R. A. Smith on June 23, 1940; and Dr. R. M. Saunders observed young, out of the nest, being fed by parents on June 7, 1940.

Mr. R. D. Ussher and the writer found this warbler to be common in suitable situations throughout the Severn Falls-Tea Lake area, June 12-18, 1938. Its presence in summer has been observed also at Otter Lake, Giant's Tomb Island, Severn Bridge, Waubaushene and Beeton Swamp.

The fall migration takes place principally during September, with a few individuals lingering into October. Messrs. D. S. Miller and G. Giles noted 16 birds at Oro Station on September 23 (1941). An individual observed at Collingwood harbour on October 9, 1939, is our latest autumn record.

Average date of spring arrival (9 years), May 13 (Barrie); earliest, April 28 (Barrie).

? May 17, 1935, Little Lake.* ♂ May 24, 1944, Holland River, Bradford.

213. **Black-capped Warbler.** *Wilsonia pusilla.*—An uncommon spring and fall transient. This is a regular migrant through the region during the latter part of May but can hardly be considered as common. A male specimen taken on May 22, 1932, at Minesing by Mr. R. J. Rutter is in the writer's collection, and another taken by Mr. T. M. Shortt on the same occasion is in the R.O.M.Z. A rather late spring migrant was noted by Messrs. J. L. Baillie, W. W. Smith and the writer at Belle Ewart on June 7, 1942.

Southbound migrants have been noted at Wasaga Beach as early as August 21, on which date three individuals were observed in 1938. Small numbers continue to move through the county until late in September. Mr. D. S. Miller has seen it at Oro Station on September 23 (1941), and Dr. Brereton recorded it at Little Lake on September 24 (1939).

Average date of spring arrival (6 years), May 23 (Collingwood); earliest, May 18, 1944 (Holland River, Bradford).

♂ May 22, 1932, Minesing.*
♂ May 22, 1932, Minesing.
♂ September 7, 1936, Batteaux Creek, Collingwood.

214. **Canada Warbler.** *Wilsonia canadensis.*—A fairly common spring and uncommon fall transient and a fairly common summer resident; breeds. This is one of the late warblers to arrive in spring,

seldom being recorded before the middle of May. The period of greatest numbers is reached between May 18 and 24.

In summer this species occurs sparingly throughout the region in suitable swampy woodlands. Mr. A. D. Henderson collected a set of three eggs, plus three Cowbird's eggs, at Little Lake, June 16, 1897. On June 18, 1940, Mr. J. J. Baker found a nest containing young at Big Cedar Point. It was situated on the ground, beside a mossy log, in an alder swamp. These appear to be the only nests for the county. At Holland River Mr. D. S. Miller and the writer observed young (one of which was secured) out of the nest, being fed by adults on July 30, 1939; and Dr. R. M. Saunders noted three young, recently out of the nest, attended by parents on July 7, 1940.

The Canada Warbler was found to be not uncommon at Penetanguishene by the R.O.M.Z. survey party, June 11-15, 1935. The writer found it apparently established during the breeding season at Giant's Tomb Island, June 11, 1937; Buckskin Lake, June 17, 1938; Severn Falls, June 18, 1938; Wasaga Beach, June 15, 1941; Lefroy, July 5, 1941; and Edward's Lake, July 6, 1941.

The autumnal movement takes place during August and early September. A single individual seen at Big Cedar Point on September 20, 1942, is our latest fall record.

Average date of spring arrival (14 years), May 21 (Collingwood); earliest, May 12, 1915 (Collingwood).

Imm. ♂ August 22, 1936, Holland River, Bradford.
Imm. ? July 30, 1939, Holland River, Bradford.

215. **American Redstart.** *Setophaga ruticilla.*—A very common spring and fall transient and summer resident; breeds. On the whole, this is probably the most abundant species of warbler in the county. It usually arrives from the south about the middle of May, with an occasional individual appearing a week or so earlier. The peak in numbers occurs between May 16 and 24. Young (Macoun, 1904) regarded it as "an abundant migrant at Penetanguishene."

The Redstart is widely distributed in summer, occurring in almost every type of woodland throughout the region. The writer found it quite common on Giant's Tomb Island on June 10, 1937, as well as on the adjacent mainland. Nest building is usually under way by June 1. At Big Cedar Point a newly completed, but empty, nest, and another containing one egg were observed on June 2 (1940). Completed sets of eggs (five) have been found as early as June 7 (1942) at Belle Ewart by Mr. W. W. Smith; and Baillie and Harrington (1937) report a set of five eggs on June 9 (1927) at Wasaga Beach. A nest containing four small young was found by the writer at Wasdell Falls on June 21 (1939); and young, just out of the nest, have been noted at Wasaga Beach on July 1 (1937). Late broods of this species are occasionally encountered; a nest at Wasaga Beach contained three eggs on July 17 (1938), and it was July 31 before the young flew. Mr. D. S. Miller found a nest with three young at Oro Station on July 22, 1937. Baillie and Harrington (1937) record the finding of a nest with three young on July 25, 1914, at Wasaga Beach, and the writer observed a pair feeding a young Cowbird there on August 7, 1937.

The southward movement takes place from early August to late September, with a peak evident between August 20 and September 15. Several migrants were noted at Oro Station on September 24, 1941, by Mr. D. S. Miller; and a late straggler was observed by Mr. J. L. Baillie at Wasaga Beach on October 1, 1927.

Average date of spring arrival (13 years), May 16 (Collingwood); earliest, May 5, 1938 (Barrie).

♂ May 15, 1888, Orillia.*
♂ May 16, 1888, Orillia.*
♀ May 16, 1888, Orillia.*
? May 17, 1925, Little Lake.*
♂ June 10, 1937, Giant's Tomb Island

216. **English Sparrow.** *Passer domesticus.*—A very common resident; breeds. As far as can be learned this introduced species first appeared in the county between 1875 and 1880. Subsequently, its increase was very rapid. During the last decade, however, its numbers appear to have decreased somewhat, owing chiefly to the increased use of the automobile in place of the horse. It is still a very common resident in towns and villages and about farm-buildings where sufficient waste grain is found to enable it to exist throughout the winter.

Nesting activities are commenced in early spring before most other species have returned from the south. Thus it has first choice of the available nesting sites, usually to the detriment of more desirable cavity-nesting birds. Two or more broods are raised in a season. Baillie and Harrington (1937) have recorded a set of five eggs (in R.O.M.Z.) taken on May 30, 1921, at Barrie, and a nest with four young found at Wasaga Beach on July 1, 1913; also, a nest with four eggs found at Midland on June 30, 1935, by Mr. R. Standfield. A nest containing five small young was noted at Holland River by the writer on May 15, 1938. Besides utilizing cavities about buildings, the English Sparrow occasionally nests in trees, building bulky globe-shaped nests having an opening at the side. Such nests have been observed by the writer at Fennell's Corners; and Mr. H. P. Bingham reports having found one containing five eggs in the top of a small spruce near Little Lake on June 6, 1929.

♂ February 28, 1937, Holland River, Bradford.
♀ February 28, 1937, Holland River, Bradford.

217. **Bobolink.** *Dolichonyx oryzivorus.*—A common spring and fall transient and summer resident; breeds. The first spring arrivals of this conspicuous inhabitant of our meadows usually appear during the second week of May. A flock of eight males was encountered at the Nottawasaga River, near Angus, on May 11, 1941. By May 24 the majority of migrants have passed northward and the local summer population has become established in suitable breeding areas. Grassy pastures, meadows and the drier edges of marshes afford favourite nesting habitats for this species.

Bingham (1923) reported a nest of six eggs about June 1, 1922, three miles from Barrie; and a set of five eggs taken by the same observer on July 12, 1919, has been recorded by Baillie and Harrington (1937). The Bobolink is quite common in some of the drier, grassy sections of the Holland River Marsh where a nest containing four eggs was found by the writer on June 5, 1938. Young on the wing have been noted there on July 2 (1939). At Phelpston a nest was found containing one young bird, about ready to fly, and two infertile eggs on June 23, 1939.

The flocking of males has been noted at Holland River as early as July 7 (1940) and by the end of the month the southward migration is under way. The movement continues during August and the first part of September. Dr. Brereton reported a flock of 50 birds at Barrie on September 2, 1940; and the writer observed a concentration of over 400 birds at Edward's Lake on August 24, 1942. Two individuals seen at Holland River on September 14, 1937, constitute our latest fall record.

A male specimen taken at the Holland River Marsh on July 10, 1937, was just beginning to show a few breast feathers of the fall plumage.

Average date of spring arrival (8 years), May 10 (Barrie); earliest, May 4, 1938 (Barrie).

♂ May 16, 1930, Little Lake.* ♂ July 10, 1937, Holland River, Bradford.

218. **Eastern Meadowlark.** *Sturnella magna.*—A very common spring and fall transient and a common summer resident; breeds. One of the earliest of the spring migrants, the Meadowlark's arrival follows closely upon that of the Bluebird and Killdeer. Mr. F. E. Courtice

has recorded it at Collingwood as early as March 15 (1921); and Dr. Brereton found three singing males at Barrie on March 16 (1938). Its normal time of arrival is about March 30, and the movement continues during most of April.

In summer it is well distributed throughout the county, breeding commonly in fields and meadows. Nests with full complements of eggs (five) have been found as early as May 11 (1941) at Big Cedar Point by Mr. W. W. Smith. On May 29, 1934, Mr. H. P. Bingham collected a set of five eggs near Barrie, and also another set of four eggs on June 28, 1928, now in the R.O.M.Z. Young in the nest have been found as early as May 22 (1938) at Big Cedar Point by Mr. W. W. Smith; and a nest found by the writer at Hillsdale contained four young, about a week old, on June 12 (1938). Young, just able to fly, were observed at the Holland River on July 7, 1940, by Mr. D. S. Miller.

In late summer this species gathers in small loose flocks preparatory to leaving for the south. The peak of the southward movement takes place between September 15 and October 15, during which period flocks containing upwards of 30 individuals are frequently encountered. Our latest autumn record is that given by Atkinson (1892) who reported several at Holland River on October 21, 1890.

A mounted specimen in the Debenham collection was taken at Dalson about 1910.

Average date of spring arrival (15 years), March 30 (Collingwood).

? May 15, 1888, Orillia.*

219. **Red-winged Blackbird.** *Agelaius phoeniceus.*—A very common spring and fall transient and summer resident; rare winter visitant; breeds. This species usually arrives during the latter part of March, and at times as early as March 16 (1921, Collingwood). Heavy flights of migrants occur during April.

Head (1829) reported shooting a Red-winged Blackbird at the Holland River on April 26 [1815]. He states in part: "I shot a few birds . . . one a sort of reed-sparrow, the size of a thrush, and of a rich, dead-black plumage; the shoulders of the wings a brilliant scarlet, tempered off with yellow."

In summer it is a very common breeding bird in suitable marshes throughout the county. Nests with full complements of eggs have been found as early as May 9 (1938) at Barrie by Mr. H. P. Bingham, and a set of four eggs taken by him at Little Lake on May 28, 1919, is in the R.O.M.Z. Our latest date for eggs is June 22 (a set of four found by the writer at Little Lake in 1939). The earliest date for fledgelings leaving the nest is June 13 (1939, Marl Lake). Other nesting colonies have been examined at Holland River, Matchedash Bay, Otter Lake, McDonald's Rapids, Buckskin Lake and Severn Bridge.

Flocking commences in July, and in August large numbers may be seen congregating nightly in the marshes. Thurston and others (1892) reported "flocks of thousands . . . all down the [Holland] River to Cook's Bay" on August 16, 1890. Fully 300 birds were seen feeding in the marsh at Little Lake by Dr. Brereton on September 13, 1941. Considerable numbers are to be found moving southward through the county during October, at which time they are usually associated with mixed flocks of Rusty and Crow Blackbirds. Our latest fall record is that of two individuals noted at Mud Lake, near Anten Mills, by Dr. Brereton on November 5, 1938.

The only winter occurrence for this species was established on December 27, 1943, when a lone individual was observed at a feeding table at Ovenden College, Barrie, by Dr. Brereton, Jim Gilmour and Ralph Knowles. This bird was seen daily for a period of two weeks.

Average date of spring arrival (10 years), March 30 (Collingwood).

♂ September 21, 1887, Orillia.*
♀ May 8, 1888, Orillia.*
♀ May 18, 1925, Little Lake.*
♀ April 24, 1930, Little Lake.*
♀ May 13, 1933, Barrie.
♂ May 13, 1933, Barrie.
♂ April 19, 1935, Cranberry Lake.

220. **Baltimore Oriole.** *Icterus galbula.*—A fairly common spring and uncommon fall transient and a fairly common summer resident; breeds. The Baltimore Oriole usually arrives during the second week of May, with an occasional individual sometimes appearing during the first week. The earliest spring arrival date is May 2, 1942, when a singing male was seen at Barrie by Dr. Brereton. The peak of the migration appears to occur between May 10 and 20. Atkinson (1892) reported collecting three specimens at Orillia on May 24, 1890.

This species is a fairly common breeding bird throughout the county, nesting in trees along highways and in shade-trees in towns and about farms. Its pendent nest has been found in a variety of trees, chiefly elms and maples, and less frequently in birches and aspen poplars. The earliest date for eggs is June 2, Mr. J. J. Baker having examined a nest containing three eggs at Big Cedar Point in 1935. Mr. H. P. Bingham found a nest of four eggs at Barrie on June 4, 1915 (Baillie and Harrington, 1937). Young birds, recently out of the nest and being fed by parents, were observed by the writer at Wasaga Beach on June 24, 1933; and at Hawkestone Mr. D. S. Miller found a nest containing four young on June 26, 1936. Nests have also been noted at Penetanguishene (June 7, 1937); Holland River (June 5, 1938); North River (June 12, 1938); and Hogg's Bay (June 15, 1939).

The southward migration takes place mainly during August and by September 1 only a few remain. An individual noted at Wasaga Beach on September 4, 1939, is our latest autumn record.

Average date of spring arrival (14 years), May 11 (Collingwood).

♀ May 12, 1888, Orillia.*
♀ May 26, 1890, Hawkestone.*
♀ May 23, 1930, Shanty Bay.*
♀ June 3, 1932, Little Lake.*
♀ May 22, 1932, Minesing.*
♂ June 17, 1941, Marl Lake.

221. **Rusty Blackbird.** *Euphagus carolinus.*—A fairly common spring and a very common fall transient; rare winter visitant. The first Rusty Blackbirds usually arrive about the second week of April, and during their period of maximum abundance from April 16 to 30 flocks numbering upwards of 100 individuals have been recorded. May 16 (1931) is the latest date for transients, on which occasion two individuals were noted at Minesing by members of the Brodie Club of Toronto. This species is not known to have nested in the county.

In the fall it is an abundant migrant in late September and throughout October. Southbound transients have been noted at Barrie as early as September 24 (1939), and Mr. D. S. Miller observed 200 birds at Oro Station, September 25 (1941). Atkinson (1892) reported large flocks at Holland River on October 18, 1890; and the writer noted 500 birds there on October 27, 1935. An individual observed at Wasaga Beach on November 11, 1934, is our latest fall record.

A specimen collected at Little Lake on March 10, 1930, by Mr. H. B. Haugh establishes its only occurrence in winter.

Average date of spring arrival (5 years), April 18 (Barrie); earliest, March 29, 1942 (Belle Ewart).

2 ♂ ♂ September 21, 1887, Orillia.*
♂ September 29, 1928, Wasaga Beach.*
♂ March 10, 1930, Little Lake.*
2 ♂ ♂ May 5, 1934, Stroud.
♀ October 27, 1935, Holland River, Bradford.

222. **Crow Blackbird.** *Quiscalus quiscula.*—A very common spring and fall transient and summer resident; breeds. This species arrives with the first wave of early spring migrants towards the end of March, the movement reaching its height between March 30 and April 20.

The Crow Blackbird is a very common breeding bird throughout the county, nesting in a variety of situations such as swampy woods, coniferous trees about dwellings, and occasionally on the structural framework of bridges. Nest building is under way by the last week of April, and most nests have eggs by May 1. An exceptionally early nest containing five eggs was found by Mr. R. A. Smith in the eavestrough of the Bradford railway station on April 18, 1939.

Undoubtedly the heaviest concentration of nesting birds is to be found in the Minesing Swamp. Bingham (1926) reported "hundreds of pairs nesting in every conceivable place,—in vines, tops of old stubs and in crotches of trees, some two or three feet from the ground." Of eleven nests examined by the writer at Minesing on May 11, 1941, six contained five eggs each; three, four eggs each; one, one egg; and one, three recently hatched young, plus one egg. A set of four eggs taken by Mr. H. P. Bingham on May 1, 1920, is in the R.O.M.Z., as is a set of four eggs collected at Minesing by Dr. C. H. D. Clarke on May 17, 1931. This species was found to be a common breeding bird in the Severn Falls-Tea Lake region in 1938, although the nests appeared to be some two weeks behind those at Minesing. Nests containing three and five eggs each were found at McDonald's Rapids on June 14 (1938). Numbers of these birds breed each year in the ornamental cedars at the home of Mr. F. E. Courtice in Collingwood. In 1940 an effort was made to discourage the birds by the removal of some 42 eggs from nests, but this proved of little avail for adults were observed carrying food to young on June 10. Atkinson (1892) reported the finding of a nest containing four full-fledged young on May 26, 1890, at Orillia. Young on the wing, being fed by parents, have been noted at Wasaga Beach as late as July 13 (1941).

Flocking begins in July and becomes pronounced in late August, when flocks numbering many hundreds of individuals are to be seen moving southward. Often associated with mixed flocks of Rusty and Red-winged Blackbirds, this species continues to pass through the region during September and October. Ten individuals noted in a mixed flock of blackbirds on October 22, 1939, at Bradford, constitute our latest fall record.

Average date of spring arrival (14 years), March 25 (Collingwood); earliest, March 11, 1921 (Collingwood).

♂ April 20, 1888, Orillia.*
♂ April 21, 1888, Orillia.*
♀ May 4, 1888, Orillia.*
♂ May 26, 1890, Hawkestone.*
♀ May 24, 1892, Orillia.*
Juv. ? June 8, 1928, Minesing.*
♂ May 13, 1930, Little Lake.*
2 ♂ ♂ May 22, 1932, Minesing.
♂ April 19, 1935, Wasaga Beach.

223. Cowbird. *Molothrus ater.*—A common spring and fall transient and a common summer resident; breeds. Small flocks of migrating

Cowbirds are in evidence about the first week of April, and in mild springs during the last week of March. Mr. F. E. Courtice has recorded it as early as March 23 (1921) at Collingwood. The movement reaches its peak between April 6 to May 2. In 1938 Mr. D. S. Miller observed flocks of 30 and 60 individuals on May 1 and 2, respectively, at Oro Station.

The Cowbird is generally distributed throughout the county in summer, somewhat less commonly in wooded areas bordering the Severn River than farther south. The parasitic habits of this species are well known. Cowbirds were reported as being very plentiful in the Georgian Bay district by Starr (1923), who says that "few warbler nests escape them." Instances of parasitism by this species in Simcoe County have been reported by Harrington (1922 and 1924), Baillie and Harrington (1937), and Friedman (1938). Some 37 species of birds which have fallen victims of the Cowbird have come to the writer's attention. These include four species of flycatchers, fourteen species of warblers, and eight species of sparrows. For the Barrie area Mr. H. P. Bingham has a list of thirty species victimized by the Cowbird. Birds most frequently parasitized include the Song Sparrow, Red-eyed Vireo, Redstart, Yellow Warbler, Chipping Sparrow and Savannah Sparrow. The earliest date for Cowbird's eggs is May 8 (1938), when Mr. Don Sutherland found two eggs in a nest with one Song Sparrow's egg at Holland River. The latest egg was found by Dr. Harrington in the nest of a Myrtle Warbler at Wasaga Beach on July 17, 1914 (Baillie and Harrington, 1937). On September 2, 1940, the writer saw a full-grown young Cowbird being fed by a Red-eyed Vireo at Wasaga Beach.

The fall migration takes place in September and October, with the period of greatest numbers occurring between September 20 and October 15. Dr. Brereton reported a flock of 150 birds at Barrie on October 2, 1941. Atkinson (1892) saw small flocks at the Holland River on October 17, 1890; and the writer noted five individuals in the same locality on October 17, 1937.

Average date of spring arrival (12 years), April 4 (Collingwood).

♂ April 30, 1888, Orillia.*
? May 8, 1925, Little Lake.*
♂ May 9, 1925, Minesing.*
♂ May 6, 1934, Innisfil township.
♂ April 19, 1935, Wasaga Beach.
♀ April 25, 1935, Gilford.

224. **Scarlet Tanager.** *Piranga erythromelas.*—An uncommon spring and rare fall transient, and an uncommon summer resident; breeds. The first male Scarlet Tanagers usually arrive about the middle of May, and small groups of from two to six individuals are

to be seen passing through the region until about May 30. Four beautiful males in one tree were observed by the writer at Holland River on May 22, 1938, and on May 20, 1934, three males were seen together at Wasaga Beach. Mr. W. W. Gunn reported observing a male and female at Penetanguishene on May 26, 1939.

While not particularly common, this species is generally distributed throughout the county in summer, nesting chiefly in open hardwood forests of the maple-beech type. In some districts it may even assume the status of common. Young (Macoun, 1904) reported it as "a common and breeding summer resident at Penetanguishene," and Swainson and Richardson (1831) described a male specimen collected there in 1825. A set of four eggs was taken at Barrie by Mr. H. P. Bingham on June 2, 1918, and Dr. Harrington found a partially completed nest at Wasaga Beach on June 9, 1923 (Baillie and Harrington, 1937). Mr. J. C. Hall (MS) reports the finding of this bird nesting in Tossoronto township, near Lisle, on August 5, 1939.

A singing male apparently established on its breeding territory was observed on Giant's Tomb Island, June 11, 1937; and Mr. R. D. Ussher and the writer found it to be fairly common along the Severn River, five singing males having been noted near Severn Falls on June 17, 1938.

The fall migration takes place in late August and during September; at this season, however, the males assume an inconspicuous plumage similar to that of the females and few are recorded. Moulting adult males in variegated red and green plumage were observed at Wasaga Beach on August 26 and September 7, 1942.

A male specimen taken at Orillia by Dr. Walker on September 30, 1887, constitutes our latest autumn record.

Average date of spring arrival (6 years), May 18 (Barrie); earliest, May 8, 1938 (Barrie).

2 ♂ ♂ September 27, 1887, Orillia.* ♂ June 4, 1937, Holland River, Bradford.
♂ September 30, 1887, Orillia.*

225. Cardinal. *Richmondena cardinalis.*—A rare resident; breeds. Of casual occurrence in the county up to 1938, this species has apparently become established as a resident in at least one locality. The earliest record of a Cardinal is that of Young (Macoun, 1904) who reported the taking of a female at Penetanguishene on February 14, 1901. Prior to 1938 there were only sporadic records, one or two birds having been seen in certain localities for a short period. A pair was reported by Dr. Harrington to have spent the summer of 1926 at Collingwood. Dr. Brereton observed one regularly for about a month at Barrie during January, 1933.

A marked incursion of Cardinals occurred throughout Southern Ontario during the fall and winter of 1938-39. The first Simcoe County report came from Little Lake where Mr. H. B. Haugh saw two males and a female on December 6, 1938. Two males remained in the vicinity until January 21, 1939. Dr. R. M. Saunders observed two at Collingwood on January 31, 1939; and Mr. G. Lambert noted six birds near Stroud on February 4, 1939. Four males were seen at Holland River on February 21, 1939, by Mr. D. Sutherland.

On January 4, 1939, a pair appeared at the feeding station of Mr. G. W. Snell at Orillia and news of the event appeared in the Toronto **Globe and Mail** of March 6, 1939. This pair became established and evidently nested successfully, for on August 16 the adults and two young, just able to fly, came to the station. A pair remained in the vicinity and probably nested during 1940. On June 11, 1941, the writer watched a pair come to the Snell feeding station and, after a search of nearby gardens, succeeded in finding the nest. It contained three half-grown young and was situated eight feet up in a honeysuckle bush on the property of Mr. D. H. McGill, Tecumseh Street.

Other occurrences include a single bird seen regularly from January to March, 1941, at the farm of Mr. W. Goodfellow at Edenvale; a female noted at Midland by Dr. L. E. Jaquith on August 18, 1941; a pair seen by Major Mark Robinson at his feeding station at Barrie on November 13, 1941; a male observed at Big Cedar Point on April 25, 1943; and a female at Ovenden College, Barrie, on December 11, 1943. According to information received at the R.O.M.Z. by Mr. J. L. Baillie, a Cardinal came to the feeding station of Mrs. Lila Patterson at Waubaushene during the first week of November, 1943.

226. **Rose-breasted Grosbeak.** *Hedymeles ludovicianus.*—A fairly common spring and fall transient and summer resident; breeds. This species usually arrives about the middle of May, reaching its maximum numbers between May 16 and 24.

It is generally distributed throughout the county in summer, frequenting the younger second-growth woods bordering streams or swamps. Nest building is under way in late May. At Big Cedar Point a nest containing one egg was found as early as May 25 (1941) by Mr. W. W. Smith, and completed sets of four eggs on June 5 (1938). In 1939 the same observer located four occupied nests in slender trees in a swampy section of the point. Young (Macoun, 1909) regarded it as "a breeding summer resident at Penetanguishene." Baillie and Harrington (1937) recorded a set of four eggs taken at Barrie by Mr. H. P. Bingham, June 4, 1916, and a set of four eggs, plus two Cowbird's eggs, taken at Orr Lake on June 7, 1929. A set of four eggs was found near Severn Falls by the writer on June 14, 1938. Young, out of the nest and being fed, were seen on July 7, 1940, at Holland River by Mr. R. A. Smith; and Mr. G. Lambert reported four young on the wing at Glenview Beach, Innisfil township, on July 21, 1940.

The southward movement takes place in late August and early September. Six birds were observed at Holland River on September 12, 1937. Two individuals noted in Minesing Swamp by Mr. A. Helmsley on October 10, 1938, constitute our latest autumn record.

Average date of spring arrival (8 years), May 15 (Barrie); earliest, May 7, 1938 (Barrie).

♀ May 20, 1888, Orillia.*
♀ May 12, 1930, Little Lake.*
♂ May 21, 1932, Minesing.
Imm. ♂ September 6, 1937, Batteaux Creek, Collingwood.

227. **Indigo Bunting.** *Passerina cyanea.*—A rather uncommon spring and fall transient and a fairly common summer resident; breeds. The Indigo Bunting is a rather late spring arrival, rarely appearing before the third week of May. At the height of the movement, on May 28 (1938), three males were recorded by Dr. Brereton at Little Lake.

In summer it is generally distributed throughout the county frequenting areas of shrubby growth, particularly where patches of raspberries prevail. Four singing males were seen by the writer on June 11, 1940, between Waubaushene and Port Severn, a distance of approximately four miles; and on June 18, 1938, five males were noted and one collected near Severn Falls. Mr. W. W. Gunn observed two individuals at Angus on June 12, 1939. A set of four eggs taken at Barrie by Mr. H. P. Bingham on June 7, 1933, has been recorded by Baillie and Harrington (1937). At Big Cedar Point Mr. W. W. Smith found a nest with three eggs three feet up in a raspberry bush on July 2, 1939. Dr. Brereton located a nest containing four eggs, plus a Cowbird's egg, on June 26, 1940, at Little Lake. A late set of four eggs, possibly a second clutch, was found on July 20, 1939, near Barrie by Mr. H. P. Bingham. On July 7, 1940, at Holland River, a nest containing three small young was shown to the writer by Mr. R. A. Smith; while two young of another brood, out of the nest, being fed by an adult, were noted on the same day.

This species is a persistent songster, continuing his vocal efforts during July and early August; one was heard singing on August 3, 1936, at the outskirts of Penetanguishene.

The southward movement takes place in September. Of two individuals seen at Barrie on September 24, 1939, one was a male in partial fall moult.

Average date of spring arrival (4 years), May 19 (Barrie); earliest, May 14, 1938 (Barrie).

♂ June 18, 1938, Severn Falls.

228. **Evening Grosbeak.** *Hesperiphona vespertina.*—Formerly an irregular winter visitant, now of regular occurrence but varying in numbers from one winter to the next. The earliest record for the county appears in the diary (in R.O.M.Z.) of J. B. Williams, who states that a single bird was seen in Barrie on May 24, 1886. Sutherland (1892) reported Evening Grosbeaks common at Orillia during January, 1890, and collected four specimens; this was the winter of the great incursion of this species into Southern Ontario and the New England States.

The Evening Grosbeak usually arrives from the north in December and occasionally earlier (November 12, 1941, Barrie). It is especially fond of the seeds of the Manitoba maple or box elder and the presence of this food acts as an inducement for many to spend the winter. Other flocks pass through the county to points south and east, returning again in late March and early April to swell the local wintering population. Mr. F. E. Courtice has recorded it regularly in winter at Collingwood since 1912; his earliest fall occurrence date is October 20 (1918). It is present in varying numbers at Barrie each winter. Dr. Brereton estimated a population of 100 individuals during the winter of 1936-37. In other years from 20 to 50 birds have been found. Brereton and Laws (1942) reported 54 birds at Barrie on December 26, 1941. The majority move northward in April, but a few remain well into May. A specimen found dead in Barrie on May 9, 1931, by Dr. Brereton is in the Ovenden College collection. Mr. D. F. MacLaren reported 12 birds in Barrie on May 19, 1939. The writer has noted it at Wasaga Beach as late as May 21 (1921); and Mrs. F. E. Courtice informs me that in 1940 a small flock remained in Collingwood until May 28.

There is no evidence of this species having summered in the county. That it is gradually extending its summer breeding range eastward there can be no doubt, and its nesting in northern sections of the county can be considered a future possibility.

? March 23, 1925, Little Lake.*
2 ♂ ♂ March 25, 1925, Little Lake.*
♂ January 10, 1940, Barrie.
♀ January 10, 1940, Barrie.

229. **Common Purple Finch.** *Carpodacus purpureus.*—A fairly common spring and uncommon fall transient, a fairly common summer resident and a variable, rare or fairly common winter visitant; breeds. This species has been recorded in every month of the year. Young (1905) reported finding it near Penetanguishene on February 17, 1905. Numerous flocks spent the winter of 1914-15 in Collingwood, feeding on mountain ash berries, according to Mr. S. H. Henry; and Mr. F. E. Courtice observed it there during the winter of 1924-25. At Barrie Dr. Brereton reported it unusually common during the winter of 1939-40. Returning flocks of northbound migrants are in evidence in April, and in the fall a definite, though less clearly defined. southward movement takes place during October.

The Purple Finch occurs throughout the county in summer, being distributed rather sparingly in the southern townships and fairly commonly in northern sections, especially in growths of black spruce. Baillie and Harrington (1937) record the taking of a set of four eggs at Barrie on July 15, 1915, by Mr. H. B. Haugh and a set of five eggs on June 18, 1916, by Mr. H. P. Bingham. The earliest date for a completed set of eggs is May 27 (1931), when one of five eggs was found by Mr. H. P. Bingham in Vespra township, near Barrie. At Dalston the same observer found a nest containing three eggs, plus a Cowbird's egg, 50 feet up in a spruce on June 3, 1931. Mr. R. D. Ussher located a nest of four eggs at Tea Lake on June 16, 1938. Two young, recently out of the nest and being fed by adults, were observed by Mr. D. S. Miller at Oro Station on July 1, 1937; and four young, attended by adults, were seen by Mr. G. Lambert at Glenwood Beach on July 16, 1939. Also, it has been noted in summer on Giant's Tomb Island; at Wasaga Beach; Sparrow Lake; and along the Holland River.

♂ April 20, 1888, Orillia.*
♀ April 24, 1888, Orillia.*
♂ May 1, 1888, Orillia.*
♂ March 12, 1925, Little Lake.*
♂ May 6, 1934, Stroud.
♂ May 24, 1937, Wasaga Beach.
♀ February 15, 1941, Barrie.
♂ April 11, 1941, Bradford.

230. **Pine Grosbeak.** *Pinicola enucleator.*—An irregular winter visitant. During some winters large numbers of these northern grosbeaks appear in the county; in other years only occasional birds or small flocks are recorded.

Young (Macoun, 1904) reported it as "very plentiful during the winter of 1900 and 1901" at Penetanguishene. An invasion of Pine Grosbeaks occurred over much of Southern Ontario during the winter of 1929-30; at Little Lake Mr. H. B. Haugh secured a number of specimens, as listed below, which are now in the R.O.M.Z. Another marked flight took place in 1937-8, and the species was generally common during the winters of 1939-40 and 1940-41.

Migrants usually appear in November or December (earliest, November 8, 1941), remain until March and occasionally as late as April (latest, April 27, 1938, Barrie). Flocks consisting of from four to fifty individuals were noted regularly by the writer from November, 1939, to February, 1940. Few were recorded during the fall of 1940 but in January, 1941, the species appeared in large numbers. Dr. Brereton reported nine birds at Elmvale on January 4 and found it quite common at Barrie, observing 100 individuals on January 11, 60 on January 25, and 65 on February 2.

2 ♀ ♀ March 3, 1930, Little Lake.*
♂ March 3, 1930, Little Lake.*
2 ♂ ♂ March 12, 1930, Little Lake.*
♀ February 28, 1937, Holland River, Bradford.
♀ December 25, 1937, Holland River, Bradford.
♂ January 16, 1938, Churchill.
♀ January 27, 1941, Barrie.*

231. **Arctic Redpoll.** *Acanthis hornemanni.*—A rare winter visitant, usually found associated with flocks of the next species. A specimen taken at Orillia in November, 1895, by Mr. G. E. Atkinson, is in the collection of the National Museum at Ottawa.

With a little practice it is not difficult to recognize individuals of this species in flocks of the Redpolled Linnet. On March 27, 1938, V. Crich and the writer observed a single bird near Churchill; and Dr. Brereton identified an individual in a flock of five Redpolled Linnets at Barrie on March 6, 1939. A specimen secured by the latter observer at Essa Station on March 8, 1941, is now in the writer's collection and appears typical of the American form of this species, the Hoary Redpoll, *A. h. exilipes.* Mr. C. E. Molony, Dr. Brereton and the writer observed another unmistakable individual in a flock of 40 *linaria* at Midhurst on March 30, 1941.

♀ March 8, 1941, Essa Station.

232. **Redpolled Linnet.** *Acanthis linaria.*—An irregular winter visitant. Another northern finch the numbers of which fluctuate greatly from year to year. During winters of abundance it usually arrives in October or November (earliest, October 20, 1935, Holland River) and remains until March or April (latest, April 22, 1939, Little Lake).

Young (1905) found it common at Penetanguishene during the winter of 1904-5 and described it (Macoun, 1904) as "an abundant winter visitant—early in October." Mr. F. E. Courtice reported it at Collingwood on February 24, 1916, and Mr. S. H. Henry observed a flock of about 100 birds at Batteaux Creek on April 8, 1916. It was abundant during the winter of 1937-8 from November 7, when five were seen at the Holland River by Mr. F. H. Emery, until April 10, when twelve were noted at Willow Creek by Dr. Brereton. Great flocks were observed during March, 1938. One, composed of 1000 birds, was reported at Barrie by Dr. Brereton on March 5; and Messrs. Crich, Molony and the writer witnessed a great concentration, estimated at 3000 individuals, at Simcoe Heights, near Churchill, on March 27.

This species was not reported during the fall of 1938, but appeared in considerable numbers during February and March, 1939. Decidedly rare during the winter of 1939-40, it arrived in numbers in January, 1941, when flocks of from 10 to 35 individuals were noted regularly at the Holland River, and Dr. Brereton reported it common at Barrie from January to March, observing 100 birds on March 30.

Several specimens taken at Orillia in 1888 by Dr. Walker, are in the R.O.M.Z. Specimens collected are referable to the common form, *A. l. linaria*.

♀ April 2, 1888, Orillia.* ♂ October 20, 1935, Holland River, Bradford.
♀ April 19, 1888, Orillia.* ♂ December 26, 1941, Holland River, Bradford.

233. **Pine Siskin.** *Spinus pinus.*—A rather irregular transient and winter visitant; a very rare summer resident. This species has been recorded in nine of the twelve months of the year, the exceptions being July, August and September. Fall migrants usually appear from the north in October or November in flocks of from 10 to 50 individuals (earliest, October 15, 1936, Wasaga Beach). At Holland River about 100 birds were observed on November 12, 1939. It is present each winter in variable numbers, being abundant during some years and uncommon in others. Young (Macoun, 1904) considered it "a winter resident at Penetanguishene." The winter of 1937-38 saw it generally common and from 50 to 200 individuals could be observed in a day. Small groups have been noted until well into May; a flock of five seen at Holland River, May 8, 1938; and a flock composed of six individuals noted at Wasaga Beach on May 23, 1937.

The only summer occurrence is that reported by Dr. Harrington of a singing male observed on several occasions during June, 1922, along the Nottawasaga River at Wasaga Beach. Although no breeding records are available for the county it seems probable that an occasional pair remain to nest, especially since a newly completed nest was found by Dr. Harrington on April 3, 1927, on the southeastern border of the Holland River Marsh in York County (Snyder, 1930).

♀ April 1, 1930, Little Lake.*
♂ April 9, 1930, Little Lake.*
♂ January 24, 1937, Holland River, Bradford.
♀ December 25, 1937, Holland River, Bradford.

234. **American Goldfinch.** *Spinus tristis.*—A common transient and summer resident and an uncommon winter resident; breeds. Although the American Goldfinch occurs both winter and summer, the wintering population is comparatively small and its numbers are subject to considerable fluctuation. In late April and early May it becomes common with the arrival of flocks of spring migrants.

A very late breeder, this species remains in flocks throughout June and it is well on in July before nesting activities are commenced. The earliest date for a nest with eggs is July 13 (1915) when Mr. H. P. Bingham collected a set of five eggs at Barrie; and the latest, a set of five eggs found at Wasaga Beach on August 22 (1920) by Dr. Harrington (Baillie and Harrington, 1937). Young (Macoun, 1904) considered it "an abundant summer breeding resident at Penetanguishene." Dr. Harrington (1915) reported finding a nest of six eggs at Wasaga Beach on July 28, 1914. At Holland River in 1937 a nest containing four young was observed by the writer on August 28, and a nest of three young found by Mr. C. E. Hope as late as September 11.

The southward movement takes place in late September and early October, during which period flocks numbering upwards of fifty individuals are to be seen.

2 ♂ ♂ August 12, 1887, Orillia.*
♀ August 30, 1887, Orillia.*
♀ September 30, 1887, Orillia.*
♀ April 25, 1935, Gilford.
♂ April 25, 1935, Gilford.
Juv. ? September 11, 1937, Holland River, Bradford.

235. **Red Crossbill.** *Loxia curvirostra.*—An uncommon to rare winter and spring visitant; very rare summer visitant. This species is of irregular occurrence, being present one year and subsequently unreported for several years. When with us it is usually found feeding on the seeds of coniferous trees, and here again its erratic nature is evident as it moves restlessly from one stand of evergreens to another.

Head (1829) mentioned having observed "crossbills" at Kempenfelt Bay on March 5 [1815]; and Young (Macoun, 1904) reported it as a transient visitant at Penetanguishene. Mr. S. H. Henry observed this species at Barrie on April 6, 1917.

In an unusual accident on Blake Street, Barrie, a flock of some 30

Red Crossbills came in contact with a motor truck on February 8, 1938, resulting in the destruction of 13 birds. A number of specimens were saved by Dr. Brereton, two of which are now in the R.O.M.Z., and one is in the writer's collection; several others are in the Ovenden College collection. The R.O.M.Z. specimens were examined by the late Mr. J. H. Fleming and referred to the race *Loxia curvirostra neogaea* Griscom.

Three individuals were observed feeding on black spruce at the Holland River on February 20, 1938. Dr. Brereton reported a flock of ten birds at Barrie on April 22, 1941. It has been found in summer on but one occasion, that of June 25, 1933, when three individuals, feeding on red pines, were observed by the writer at Three Mile Point, Wasaga Beach.

2 ♂ ♂ February 8, 1938, Barrie.* ♀ February 8, 1938, Barrie.

236. **White-winged Crossbill.** *Loxia leucoptera.*—Another irregular winter visitant, similar in habits to the Red Crossbill. It is the commoner of the two crossbills in the county, occurring at shorter intervals and in greater numbers than the preceding species. Dr. Harrington (MS) observed a flock of about 30 birds at the mouth of the Nottawasaga River in June, 1921. At the Holland River it has been observed as early as November 21 (1937), and on December 25 (1937) several specimens were secured from a flock of ten birds. Four individuals feeding on white pines were observed on January 23, 1938, at Barrie; and a single bird was seen at Mac on April 20, 1938, by Mr. D. S. Miller.

It was quite common during the winter of 1939-40, and some 150 individuals were observed at the Holland River on November 26. On this occasion flocks of from 10 to 20 birds were feeding chiefly on the seeds of hemlocks. Other flocks were present in January, 1940, and January, 1941. Mr. R. A. Smith noted a small flock in Bradford on December 3, 1941.

♂ December 25, 1937, Holland River, Bradford.
♀ December 25, 1937, Holland River, Bradford.

237. **Eastern Towhee.** *Pipilo erythrophthalmus.*—A fairly common spring and fall transient and summer resident; breeds. The first birds to arrive in the spring usually appear shortly after the middle of April, and the peak of the movement occurs from about April 23 to about May 15.

The Eastern Towhee is a rather scarce summer resident in the southern townships but becomes progressively more common from

Barrie northward, reaching its greatest abundance in the northern townships of Tiny, Tay and Matchedash. Young (Macoun, 1904) considered it "a common summer resident at Penetanguishene." We found it surprisingly common in the Tea Lake-Severn Falls region in June, 1938, especially in cut-over areas where brush heaps remained. Elsewhere in the county this species is to be found frequenting the brushy margins of woods where underbrush is plentiful. A set of four eggs taken on May 25, 1924, at Barrie by Mr. H. P. Bingham, and a set of three eggs taken at Wasaga Beach on August 13, 1922, by Dr. Harrington as recorded by Baillie and Harrington (1937), constitute the extreme range of dates for nests with eggs. A set of three eggs collected at Penetanguishene by Mr. C. E. Hope on June 13, 1935, is in the R.O.M.Z.

The southward movement is under way about mid-September and continues until about the middle of October. An individual observed by Dr. Brereton at Barrie on October 17, 1942, is our latest autumn record.

Average date of spring arrival (5 years), April 23 (Barrie); earliest, April 10, 1938 (Barrie).

♀ June 13, 1935, Penetanguishene.* ♂ June 17, 1938, Severn Falls.

238. **Savannah Sparrow.** *Passerculus sandwichensis.*—A very common transient and summer resident; breeds. Early spring arrivals are usually to be heard singing in our fields about the middle of April. By April 25 the species has become abundant. Our earliest spring occurrence is that of a specimen taken at Barrie on March 30, 1940, by Dr. Brereton. It was in company with a flock of Tree Sparrows at the time.

A typical bird of the open country and marsh borders, the Savannah Sparrow breeds commonly where suitable habitat exists throughout the county. It is scarce or absent in the wooded region along the Severn River. The earliest nest with eggs (set of four, plus two Cowbird's eggs in Bingham collection) was found on May 24 (1916) in Vespra township, near Barrie. Bingham (1923) recorded finding a nest of three eggs three miles from Barrie on June 1, 1922. Snyder (1930) has reported it nesting on the grassy flats of the Holland River in York County. On the north bank of the Holland River in the same type of habitat, the writer found a nest of four eggs on May 29, 1938; this nest contained newly hatched young on June 5. A nest with four eggs was shown to the writer by Mr. F. H. Emery at Bradford on June 3, 1938. The latest nest with eggs (set of four) was one reported on June 25 (1939) by Dr. Brereton at Midhurst. Other localities where definite breeding evidence has been secured include Big Cedar Point, Little Lake, Hillsdale, Cranberry Lake and Marl Lake.

Evidence of the southward migration has been noted as early as September 10, at the Holland River, on which date 25 individuals were recorded in 1939. The movement reaches its height during the latter half of this month and the early part of October. Six birds observed near Wasaga Beach by Dr. Brereton on October 13, 1941, constitute our latest autumn record.

Average date of spring arrival (8 years), April 14 (Barrie).

♂ May 26, 1890, Hawkestone.*
♂ May 12, 1930, Little Lake.*
♂ May 31, 1932, Little Lake.*
♂ June 3, 1932, Little Lake.*
♂ June 4, 1932, Little Lake.*
♂ April 25, 1935, Holland River, Bradford.
♂ March 30, 1940, Barrie.

239. **Grasshopper Sparrow.** *Ammodramus savannarum.*—A rare summer resident, decidedly local in its distribution. The presence of the Grasshopper Sparrow as a member of our summer bird population was first established in 1933 when Mr. F. H. Emery found a singing male on July 2 in a pasture field in the 12th concession of Sunnidale township, near Jack's Lake, and later pointed it out to Mr. C. E. Molony and the writer.

Another station for this inconspicuous sparrow was discovered by Mr. C. E. Hope when he observed a singing male near Penetanguishene, June 11-15, 1935 (Baillie and Harrington, 1937). Mr. F. S. Cook and the writer found several pairs apparently well established at Farlain Lake, Tiny township, north of Penetanguishene, on June 14, 1939. A male in breeding condition was collected by the writer in this locality on June 23.

♂ June 23, 1939, Farlain Lake.

240. **Leconte's Sparrow.** *Passerherbulus caudacutus.*—A rare summer resident; extremely local in its distribution; breeds. In Simcoe County Leconte's Sparrow has been found only on the extensive grassy flats of the Holland River. Its discovery there in 1937 has been recorded by Baillie and Harrington (1937) and in somewhat more detail by the writer (Devitt, 1938). This is a western species that has gradually extended its range eastward and its presence in the county appears to be of recent origin. Since 1937 it has been noted regularly each summer. Our earliest arrival date is May 24 (1944). On July 9, 1941, Dr. Brereton and the writer counted ten singing males in the marsh near Bradford.

Evidence that pointed to probable nesting was obtained on July 10, 1937, when a female collected was found to have an egg developed in the oviduct and almost ready for extrusion. Its status as a breeding bird was fully established on July 23, 1938, when a young bird, recently out of the nest, and as yet unable to fly, was found by the writer on the south side of the marsh in King township (Ussher, 1939).

Two individuals observed in the marsh on September 11, 1937, constitute our latest autumn record.

♀ July 10, 1937, Holland River, Bradford.*
♂ July 10, 1937, Holland River, Bradford.
2 ♀ ♀ July 11, 1937, Holland River, Bradford.
Juv. ♂ July 23, 1938, Holland River (King township).

241. **Henslow's Sparrow.** *Passerherbulus henslowi.*—A rare summer resident; decidedly local in its distribution. This is another of the small, inconspicuous grass sparrows having insignificant songs and secretive habits. With the exception of a singing male observed at Big Cedar Point by Mr. W. W. Smith on June 3, 1942, all available records of this species are confined to the flats of the Holland River, where Mr. F. H. Emery and the writer discovered its presence on July 10, 1937. Five singing males were noted on July 17 and on September 11 an immature female was collected by Mr. C. E. Hope. Since 1937 it has been observed regularly in summer; Mr. R. A. Smith and the writer saw three individuals on June 23, 1940, and two singing males on June 20, 1941. Ussher (1939) suggests that the advent of this species to the Holland River Marsh since 1926 may be associated with the altered drainage (see Day, 1927).

Our earliest arrival date in spring is May 29 (1938), and the latest fall occurrence, September 14 (1937).

♂ July 11, 1937, Holland River, Bradford.
Imm. ♀ September 11, 1937, Holland River, Bradford.*

242. **Vesper Sparrow.** *Pooecetes gramineus.*—A very common spring and fall transient and summer resident; breeds. One of our commonest field-inhabiting birds, the Vesper Sparrow usually makes its appearance about the second week of April. The period of greatest numbers is from April 18 to May 1.

Its distribution in summer somewhat parallels that of the Savannah Sparrow, although the present species tends to favour drier fields and has been observed nesting in sandy pine barrens in Sunnidale township. Mr. H. P. Bingham has found it nesting as early as May 22 (1938, set of four eggs) at Barrie, and Mr. W. W. Smith observed a nest containing two eggs, plus a Cowbird's egg, at Big Cedar Point on May 24 (1938). A set of three eggs taken by Dr. F. Starr at Wasaga Beach on June 7, 1923, is in the R.O.M.Z. The latest nest with eggs (set of five in Bingham collection) was found on July 8 (1915) at Barrie. At Little Lake Dr. Brereton observed a nest containing three young on June 19, 1938.

The fall migration which takes place during the latter part of September and the first half of October is characterized by noticeably larger flocks than in spring. Our latest autumn record is that of an individual observed at Holland River on October 20, 1940.

Average date of spring arrival (8 years), April 18 (Barrie); earliest, April 10, 1938 (Barrie).

♀ August 12, 1887, Orillia.* ♂ June 1, 1932, Little Lake.*
♀ September 3, 1887, Orillia.* ♂ May 24, 1944, Holland River, Bradford.
2 ♂ ♂ May 20, 1930, Barrie.*

243. **Slate-coloured Junco.** *Junco hyemalis.*—A common spring and fall transient, an uncommon winter resident, and an uncommon summer resident in the northern half of the county; breeds. Although the Slate-coloured Junco is to be found in small numbers during the winter, the great majority move farther south at this season. About the first week of April returning transient flocks are to be seen and from then to the end of the month large numbers pass through the county. Swainson and Richardson (1831) describe a specimen taken at Penetanguishene in April, 1825.

As a summer resident it is largely confined to the northern townships of Matchedash, North Orillia, Tay, Tiny, Flos and Sunnidale, but also occurs sparingly along the higher ridges of the Blue Mountains, in Nottawasaga township. Young (Macoun, 1904) reported it as "a common and breeding summer resident at Penetanguishene." Its status in this section would appear to have altered somewhat in late years since the R.O.M.Z. field survey party found it scarce from June 11-15, 1935, when a single specimen listed below was secured by Mr. L. L. Snyder; and Mr. F. S. Cook and the writer failed to record it there in June, 1939. Mr. R. D. Ussher and the writer encountered it fairly regularly in the rocky, wooded areas of Matchedash township from West Bay, Sparrow Lake, to Severn Falls, in June, 1938. A young bird, recently out of the nest, being fed by parents, was observed by the writer in the 12th concession of Sunnidale township, near Wasaga Beach, on June 21, 1934. According to Harrington (MS) this species was fairly common as a summer resident in the Wasaga Beach area up to 1915, but has since become rare.

Southbound migrants are in evidence in late September, and flocks composed of 25 or more individuals have been seen at Wasaga Beach as early as September 17 (1938). It reaches its greatest numbers during October, when concentrations of upwards of 150 individuals (as observed by Dr. Brereton at Little Lake on October 11, 1941) are frequently recorded. A decided decrease in numbers is apparent by November 1; a few remain throughout the winter. Three individuals were noted at Barrie by Dr. Brereton on January 16, 1939; and a flock of five birds encountered at Holland River on January 28, 1940.

The taking of an albino junco at Orillia in August, 1890, has been recorded by Melville (1892).

♀ April 22, 1888, Orillia.
♂ April 25, 1888, Orillia.
♂ April 25, 1930, Little Lake.
♂ June 14, 1935, Penetanguishene
♀ October 22, 1939, Holland River, Bradford.

244. **Red-backed Junco.** *Junco oreganus.*—Accidental visitant. This unusual species was first detected in Barrie on January 23, 1943, by Mrs. O'Brien-Saint, who noticed a junco with "pinkish" sides among the small flock of Slate-coloured Juncos that came to her feeding station. News of the "find" was conveyed to Dr. E. L. Brereton who viewed the bird on February 13 and reached the conclusion that it was a western junco typical of the *oreganus* group. In order that its identity might be confirmed he decided to collect it on March 6. The specimen, now in the writer's collection, proved to be a male and measures L. 153, W. 79, T. 68, Cul. 11, Tars. 21. After comparison with specimens in the R.O.M.Z. and from the National Museum, Ottawa, this junco seems to conform most readily to the size limitations and plumage specifications of the Montana race *Junco oreganus montanus.* A second example of this race was later secured by Dr. Brereton on October 17, 1943. Records for this junco in Eastern North America are comparatively few.

♂ March 6, 1943, Barrie.
♀ October 17, 1943, Barrie.

245. **Tree Sparrow.** *Spizella arborea.*—A very common spring and fall transient and a common winter resident. This visitor from the north usually comes to us during the first part of October and has been observed at Wasaga Beach as early as September 17 (1938, flock of 20). It is present in considerable numbers during the winter months, although it would seem that the vast majority pass beyond our southern borders, as the species is most abundant in October and April. A marked increase is evident about the first week of April, and the movement reaches its height between April 10 and 25. By the end

of the month the Tree Sparrow has largely moved on to its breeding grounds in the far north.

Swainson and Richardson (1831) have reported the taking of a specimen at Penetanguishene in April, 1825. A specimen collected at Beeton by Mr. R. J. Rutter on October 20, 1934, is in the writer's collection.

? April 19, 1888, Orillia.*
? May 1, 1888, Orillia.*
♀ October 20, 1934, Beeton.
♂ April 18, 1937, Wasaga Beach.

246. **Chipping Sparrow.** *Spizella passerina.*—A very common spring and fall transient and summer resident; breeds. The first spring arrivals of this familiar little sparrow usually appear about the last week of April, occasionally earlier. The movement appears to reach its height from about April 26 to May 5.

In summer it is generally distributed and breeds commonly throughout the county, utilizing as nesting sites not only trees and hedges about dwellings but also evergreen trees in forest clearings remote from habitations. Atkinson (1892) records the finding of a nest of two eggs at Orillia on May 26, 1890; and Young (Macoun, 1904) reported it as a breeding summer resident at Penetanguishene. A set of four eggs taken at Barrie by Mr. H. P. Bingham on May 16, 1913 (in R.O.M.Z.), and a nest of three eggs, plus two Cowbird's eggs, found at Wasaga Beach by Dr. Harrington on June 3, 1928, have been recorded by Baillie and Harrington (1937). At Glenwood Beach Mr. G. Lambert observed a nest containing four eggs on July 21, 1940 (probably a second clutch). A nest, observed at the Barrie Collegiate Institute grounds, contained young as late as July 25 (1936).

The southward migration takes place in late September and early October, during which period flocks of 12 or more individuals (as observed at Wasaga Beach on October 11, 1941) are frequently noted. Our latest autumn record concerns three birds seen at Wasaga Beach on October 15, 1933.

Average date of spring arrival (14 years), April 23 (Collingwood); earliest, April 11, 1921 (Collingwood).

? April 30, 1888, Orillia.*
♂ October 1, 1927, Wasaga Beach.*
♂ May 20, 1930, Barrie.*
♂ May 24, 1944, Holland River, Bradford.

247. **Clay-coloured Sparrow.** *Spizella pallida.*—An accidental visitant. This western sparrow has been recorded in the county upon two occasions. A female specimen (in R.O.M.Z.) collected at Hawkestone by Mr. H. B. Haugh on May 28, 1930, has been reported by Snyder (1931). A single individual was observed to good advantage,

as it sang from a tree within 20 feet of the writer, at Two Mile Point, Wasaga Beach, on June 10, 1935. Its unmarked breast, striped crown and characteristic insect-like song were clearly noted.

♀ May 28, 1930, Hawkestone.*

248. **Field Sparrow.** *Spizella pusilla.*—An uncommon spring and fall transient and an uncommon summer resident; breeds. The Field Sparrow is an early May arrival in our latitude. Our earliest record is April 26, 1942, when a singing male was observed at Wasaga Beach.

In summer its distribution is distinctly local in character since it appears to prefer shrubby pasture or waste land of a sandy nature. It is known to occur in at least four localities within the county. At Oakview Beach two nests found by Dr. Harrington on June 7, 1923, have been recorded by Starr (1923); one contained four eggs and the other three eggs plus a Cowbird's egg. In June, 1938, Mr. R. D. Ussher and the writer were surprised to find at least three singing males occupying a rocky clearing at Tea Lake, in the extreme northern part of the county; a male in breeding condition was taken on June 15. At Lafontaine Hill, near Penetanguishene, three or more pairs were found established in a sandy reforested area on June 14, 1939, and a nest containing four small young located on the ground at the base of a small tree. Several pairs were found occupying a narrow strip of pine barrens near Lefroy, Innisfil township, on June 20, 1941.

It migrates southward in October. Late occurrence records include three seen at Wasaga Beach on October 8 (1939); and an individual observed at Barrie by Dr. Brereton on October 13 (1941).

Average date of spring arrival (5 years), May 7 (Barrie).

♂ June 15, 1938, Tea Lake.

249. **Harris's Sparrow.** *Zonotrichia querula.*—An accidental visitant. An individual of this species was identified at Collingwood by Mr. S. H. Henry and Mr. P. W. Brown on May 5, 1913. A letter from Mr. Henry dated September 29, 1939, states: "There is absolutely no doubt whatever that this was the bird we saw, because both P. W. Brown, who was at that time principal of the Collingwood Collegiate, and myself looked at it for some time through the glasses—one looking through the glasses while the other called off distinguishing marks from the book, and then alternating with the other person." Dr. Brereton reported a single bird in immature plumage at Barrie on October 12, 1935.

250. **White-crowned Sparrow.** *Zonotrichia leucophrys.*—A common spring and a very common fall transient. This handsome member

of the sparrow family usually arrives from the south about the second week of May, and reaches its maximum abundance between May 12 and 20. Stragglers have been noted at Wasaga Beach as late as May 26 (1935).

During the fall migration, which takes place in late September and the first part of October, it occurs in considerably greater numbers than in spring. Southbound migrants have been noted as early as September 18 (1938), by Dr. Brereton at Mud Lake, near Anten Mills. When the movement is at its height, between October 2 and 13, as many as 100 individuals have been recorded in a day (Little Lake, October 11, 1941). Our latest autumn occurrence for this species is October 22 (1938, Little Lake).

Average date of spring arrival (11 years), May 11 (Collingwood); earliest, May 5, 1940 (Barrie).

? May 17, 1925, Little Lake.*
♂ May 12, 1937, Holland River, Bradford.
? October 13, 1936, Orillia.

251. **White-throated Sparrow.** *Zonotrichia albicollis.*—An abundant spring and fall transient, a common summer resident, and a very rare winter resident; breeds. The first early spring transients appear shortly after the middle of April, with the greatest movement taking place from April 25 to May 15.

In summer the White-throated Sparrow is generally distributed throughout the county from the Holland River to the Severn River. Its well-known, pleasing "Canada" song is one of the characteristic notes of our coniferous and mixed woods. Nesting usually takes place in June, although a set of four eggs (in Bingham collection) was found as early as May 29 (1916) at Barrie. A nest containing four eggs was discovered by Mr. R. D. Ussher at Tea Lake on June 15, 1938. Young in the nest have been found as early as June 6 (1927) at Wasaga Beach by Dr. Harrington. At Holland River a nest found by the writer on the ground in a tamarack swamp on July 10, 1938, contained two small young and one unhatched egg; young, out of the nest, being attended by parents, were seen in this area on June 22, 1940. A family group, consisting of adults and three or four young, was noted near Lefroy on July 5, 1941.

The southward migration is under way in late September and the species continues to move through the county during October. A few late migrants are occasionally recorded during the first week of November.

There are several winter records. A specimen was taken at Barrie by Dr. Brereton on January 1, 1940, and Mr. J. L. Baillie and the writer observed a single individual at Holland River on December 26, 1941.

Average date of spring arrival (14 years), April 25 (Barrie).

? September 6, 1887, Orillia.*
? April 25, 1888, Orillia.*
? May 17, 1925, Little Lake.*
♂ May 6, 1930, Little Lake.*
♀ October 22, 1939, Holland River, Bradford.

252. **Fox Sparrow.** *Passerella iliaca.*—A fairly common spring and fall transient. The Fox Sparrow, one of the largest and most striking of the sparrow family, migrates rather rapidly through the county during a short period in April. Our spring dates range from April 3 to 22. Young (Macoun, 1904) has reported it as "a rare and transient visitant at Penetanguishene."

In the fall it pays us another hurried visit in October. Southbound migrants have been recorded at Wasaga Beach as early as October 11 (1936), and Dr. Brereton has observed it at Barrie as early as October 9 (1939). A flock of 12 individuals was encountered at Holland River on October 22 (1939), and it has been seen there as late as October 24 (1937).

Average date of spring arrival (6 years), April 14 (Barrie); earliest, April 3, 1938 (Barrie).

♂ October 9, 1939, Barrie.
♂ October 22, 1939, Holland River, Bradford.

253. **Lincoln's Sparrow.** *Melospiza lincolni.*—A rare spring and uncommon fall transient. This shy and unobtrusive sparrow migrates through the county almost unnoticed and little information is available relative to its arrival in spring. It is more frequently recorded during the fall migration. Two individuals were seen at Holland River on September 10, 1939, and Mr. D. S. Miller reported two at Oro Station on September 22, 1941. At Barrie Dr. Brereton has recorded it from October 1 to as late as October 14 (1938); a female specimen collected by him on October 12, 1939, is in the writer's collection.

Lincoln's Sparrow is not known to breed in Simcoe County, although Dr. Harrington reported observing a singing male in Minesing Swamp on June 7, 1927. Snyder (1930) found it nesting locally on the south side of the Holland River Swamp, in King township, in 1926, and it seems probable that eventually it may be found nesting in some of the larger swamps of the county.

♀ October 12, 1939, Barrie.

254. **Swamp Sparrow.** *Melospiza georgiana.*—A common spring and fall transient and summer resident; breeds. The Swamp Sparrow

arrives in our marshes about the middle of April and soon makes its presence known with its loud, ringing song. Transients continue to move through the county until late in May.

In summer it is generally distributed in suitable marshy situations throughout the county. Baillie and Harrington (1937) report a set of five eggs, plus a Cowbird's egg, at Marl Lake on June 4, 1929, and also a nest of four young found at Orr Lake by Dr. Starr on June 7, 1929. The earliest nest reported is one containing five eggs on May 24 (1937), by Mr. H. P. Bingham in Vespra township, near Barrie. At the Holland River, where this species is abundant, a nest containing three eggs, plus two Cowbird's eggs, was found by Mr. W. W. Smith on May 24, 1944; and a nest with one egg and four newly hatched young was noted on June 4, 1937. In June, 1939, Mr. F. S. Cook and the writer found it abundant at Matchedash Bay in the vicinity of Waubaushene and Fesserton. It is less common in northern Matchedash township, due to the scarcity of suitable habitat, but even in this rocky area it was found established in relatively small marshy sloughs within five miles of Severn Falls on June 12, 1941, and at Tea Lake on June 16, 1938.

The autumn migration is under way in late September and continues during October. Atkinson (1892) reported observing small flocks of Swamp Sparrows at Holland River on October 18, 1890; two individuals observed in this locality by Mr. F. H. Emery on November 7, 1937, constitute our latest fall record.

Average date of spring arrival, (5 years), April 19 (Barrie); earliest, April 10, 1938 (Barrie).

? May 8, 1925, Little Lake.*
♂ May 21, 1932, Minesing.*
♂ October 10, 1931, Minesing.

255. **Song Sparrow.** *Melospiza melodia.*—A very common spring and fall transient and summer resident, and a rare winter resident; breeds. This familiar harbinger of spring is among the first early migrants to return from the south, arriving towards the middle of March or earlier. A decided increase in numbers is apparent about the first week of April, and the movement continues until about May 1.

The Song Sparrow is abundantly distributed throughout the county in summer. Young (Macoun, 1904) has reported it as "a common and breeding summer resident at Penetanguishene." Completed sets of eggs have been found at Little Lake by Mr. H. P. Bingham as early as May 6 (1935, set of five eggs). At Holland River a nest containing one egg and two Cowbird's eggs was shown to the writer by Mr. D.

Sutherland on May 8, 1938. At DeGrassi Point Mr. E. R. Hunter reported finding a nest which contained five eggs on May 27 (1933), and young birds on June 8. Baillie and Harrington (1937) noted young in the nest at Wasaga Beach as early as June 3 (1929). Young, recently out of the nest, were observed at Penetanguishene Lake by the writer on June 14 (1939) and at Severn Falls on June 17 (1938). Two and possibly three broods are raised in a season. Dr. Harrington found a nest of three eggs at Wasaga Beach on July 27 (1914). At Glenwood Beach Mr. G. Lambert saw this species building a new nest as late as July 11 (1939) and it was August 10 before the young were ready to leave the nest.

A marked increase in numbers above the normal summer population is evident in late September and during early October, when the southward movement is at its height. Atkinson (1892) reported observing small flocks moving through Holland River on October 18, 1890. By early November the species has become noticeably scarce. A few birds are occasionally recorded in winter; Dr. Brereton observed a single individual in Barrie from January 16 to 21, 1939, and two were known to have wintered there during 1939-40.

In their discussion on *Melospiza melodia* in Ontario, Fleming and Snyder (1939) state that the breeding Song Sparrows of Simcoe County are best referred to the form *Melospiza melodia melodia*, although some are "indeterminate between *melodia* and *euphonia* or are referable to *euphonia*."

Average date of spring arrival (16 years) March 22 (Collingwood)

? July 30, 1887, Orillia.*
? April 28, 1888, Orillia.*
♂ October 1, 1927, Wasaga Beach.*
♂ May 12, 1930, Little Lake.*
♂ June 3, 1932, Little Lake.*
♀ June 4, 1932, Little Lake.*
♂ June 5, 1932, Little Lake.*
♀ June 5, 1932, Little Lake.*
♂ May 22, 1932, Wasaga Beach.*
♂ April 9, 1935, Deerhurst.
♂ June 14, 1935, Penetanguishene.*
♂ October 2, 1938, Holland River, Bradford.
♀ October 2, 1938, Holland River, Bradford.

256. **Lapland Longspur.** *Calcarius lapponicus.*—This sparrow from the far north is an irregular late fall and early spring transient, and an occasional visitor during the winter months. In migration it is often found associated with flocks of Snow Buntings and Horned Larks. Individuals have been noted as early as October 14 (1940), near Elmvale; and Messrs. F. H. Emery, J. M. Speirs and G. H. Richardson observed a small flock at Wasaga Beach on October 20, 1934. Dr. Brereton has recorded it in mid-winter at Barrie on the following occasions,—January 25, 1936, 25; January 29, 1938, 10; February 27, 1938, 15; and February 17, 1939, 4. On April 6, 1941, the same

observer discovered approximately 100 Lapland Longspurs feeding in a field of uncut millet at Edenvale. The next day the flock was estimated to contain 300 individuals; several specimens were taken and are now in the writer's collection. By April 11 all but 15 birds had departed. Our latest spring occurrence is May 3, 1941, when a flock of 20 individuals was observed in a ploughed field near Stayner by Dr. Brereton.

2 ♂ ♂ April 7, 1941, Edenvale.

257. **Snow Bunting.** *Plectrophenax nivalis.*—A common to abundant late fall and early spring transient; a fairly common winter resident. The earliest record of this species for the county is that given by Head (1829), who reported observing "a few packs of snowbirds" on March 1 [1815] during a visit to Penetanguishene. Atkinson (1892) recorded "several large flocks of Snowbirds" at Holland River on October 20, 1890.

This beautiful visitor from the arctic regions usually appears in October, and has become common by November (earliest, October 13, 1936, Wasaga Beach). Great numbers undoubtedly pass beyond our southern borders to spend the winter, but flocks, often of considerable size, are to be noted regularly during December and January swirling restlessly over the snowy fields in search of weed patches. In February, March and April migrants swell the local wintering population and flocks numbering 1000 or more are occasionally encountered during this period. At Holland River a flock of about 300 birds was seen by the writer on February 10, 1935. Mr. S. H. Henry reported a flock of some 1000 birds at Collingwood on April 15, 1916; and Dr. Brereton saw an estimated 2000 individuals at Edenvale on April 7, 1941. A flock of ten birds noted by the latter observer near Stayner on May 3, 1941, establishes its latest spring occurrence.

♀ October 20, 1934, Wasaga Beach. ♀ April 18, 1935, Wasaga Beach.

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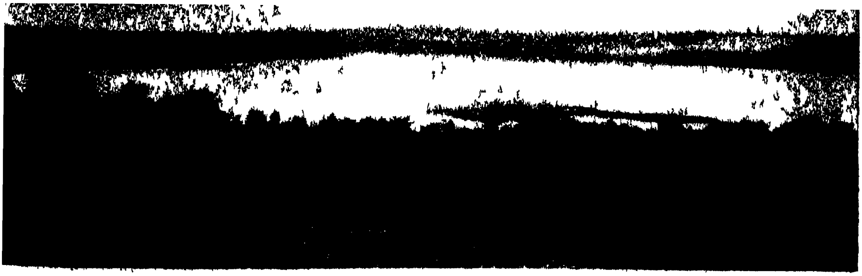
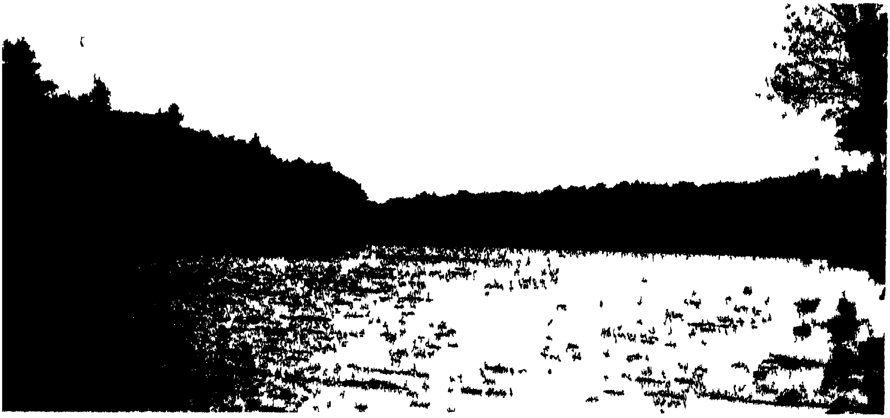
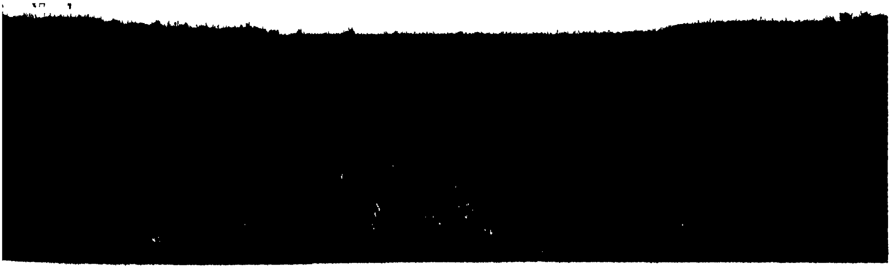
AERIAL VIEW OF WASAGA BEACH LOOKING WESTWARD TO THE BLUE MOUNTAINS



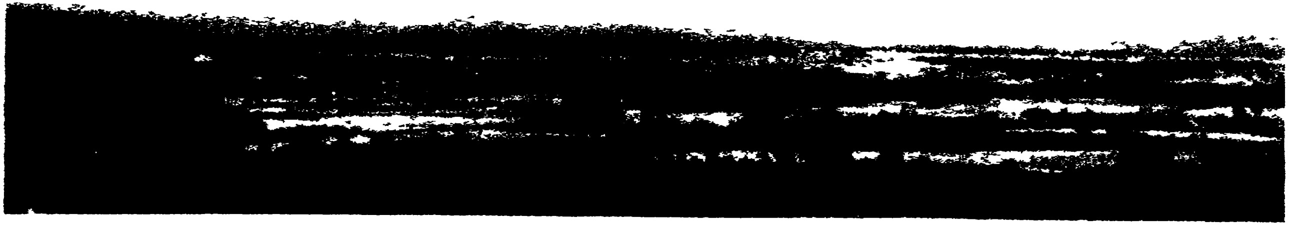
NORTHWARD FROM THE HILL AT THE SOUTHERN END OF LITTLE LAKE



The Severn River near Severn Falls



The broad expanse of the Holland River Marsh



NOTTAWASAGA BAY FROM THE BLUE MOUNTAINS. THE WHITE SANDS OF WASAGA BEACH AND THE HEAVILY WOODED VALLEY OF THE NOTTAWASAGA RIVER ARE TO BE SEEN AT THE RIGHT CENTRE

Photographs by the writer

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PEROMYSCUS MANICULATUS MACRORHINUS[1]
AND
THE PROBLEM OF INSULARITY

By T. T. McCabe
and
Ian McTaggart Cowan

It is not unusual for an investigation, inaugurated to test a hypothesis, to lead to precisely opposite conclusions. The present one threatened to become a case in point. The morphological phenomena of the higher vertebrates of the northwest coast and their singularly uniform mode and degree of variation, evidently the product of a relatively short sojourn in an extraordinary environment, have seemed, and indeed still seem, to preclude explanations based on random mutation and crossing. Whether or not operating through mutative genic mechanisms, it seems clear that the environment, in some manner which can hardly be considered "selective," in the classical sense, must furnish an original and a common ultimate impulse. The phenomenon in question, though by no means unfamiliar elsewhere, notably in the many contrasts between desert and humid forest communities, remains without cogent theoretical explanation except by vague reference to "selection",—especially ridiculous in the present area and instance.

It seemed, at the time this far too brief survey was undertaken, that an intensive examination of the only animal available in large enough quantities for serious research might reveal something of this ghostly agency. The familiar proposition was here exemplified with the near-certainty of local and recent origin, in the highest degree of environmental isolation, and in an almost unlimited number of isolated populations.

In the first place we found the acquisition of the amounts of evidence we had hoped for to be beyond our present powers. In the second we seemed to find ourselves being led straight into a jumble of heterogeneous and directionless mutations, interesting as illustrating the degree of mutability and the action of chance in small populations under natural conditions, otherwise quite without novelty or special bearing on the interpretation of the faunal problems of the region.

Gradually, however, from such a welter of confusion, some suggestion of form began to appear. The gradual understanding of the character and distribution of the race we have called ***rubriventer***, with its manifold characters which point in the direction of those of the fauna as a whole, its central position, great spread, gradual marginal disappearance, and distant sporadic occurrences which may be looked upon as forerunners, induced us to regard it not as a random isolation-product, but rather as the boldest spearpoint of a great regional and environmental tendency. Not only its boldness but its great complexity stands out among the several "racial" and subracial phenomena, the relatively slight products of mere isolation, as a vigorous and effective trend which may well, given the opportunity,—i.e. geological and climatic stability—overrun and dominate the whole area as it has the tiny archipelago of its origin.

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[1] Printed February, 1945.

It may be objected, from our own analysis of the situation, that the status of the race is not due to greater vigor and viability, greater mutation-pressure or degree of dominance, but to a lucky history,—origin on a very small area which enlarged with quick geological change to a relatively large and homogeneous group of islands with insignificant dividing channels. But this explanation does not tell the whole story. It does not explain the far greater apparent depth, variety, and complexity of these multiple modes and degrees of variation as compared to all others, nor their distant, diminishing recurrence, to the north and south, beyond the most formidable barriers in the area.

Yet even in regard to this favored race, it must be said that, in spite of the spectacular character of the variations and the suggestion of age that goes with their complexity,—and these are greater, at first glance, than those of many so-called species,—yet in the long run the characters seem as superficial as passing shadows. The impression, difficult to rationalize, that *rubriventer* is somehow to all intents and purposes, *the same mouse* as its neighbors, is very strong. If it, like the lesser races, warrants the convenience of the subspecific name we have given it, such names express no conviction on the part of the authors of any material progress toward those vague and distant degrees of variation to which the undefinable term "specificity" is intended to apply.

SECTION I

AGE AND EVOLUTION OF THE HABITAT:—THE GEOLOGICAL BACKGROUND

The unique feature of the environment under discussion is not the multiplicity of insular populations of all sizes and degrees of isolation, but their limited and more or less determinable age. Archipelagoes, oceanic or continental, are not uncommon, and enough is known of islands of many types to shadow forth more or less consistent results of insular segregation. With the exception, however, of rare and over-recent instances of volcanic devastation, or of artificial importation, we have no knowledge of populations of insular size and purity and of known degree of youth. The importance of this factor justifies a review of geological opinion upon the antiquity of the habitable state of the area under consideration, which is not believed continuously to antedate the latest stages of the last or Vashon glaciation.

Of the great amount of geological work on the historical geology of the northwest, the coast has received a poor modicum, and its past must appear, in some degree, in the light of the greater body of cumulative evidence from the intermountain trough, whose ice-cap, not only in the great transmontane valleys, but over most of the summits, was continuous with the Pacific piedmont sheet. Therefore this section will be devoted to the review of expert opinion on the regions west of the Rockies and north of the limit of ice-gap glaciation.

Not only have the Pleistocene and Recent been subordinated or completely neglected in almost all post-Dawsonian research except that of W. A. Johnson, but what has been published is largely concerned with controversy on the numbers of glaciations or, on the coast in particular, on preglacial faulting and erosion as opposed to glacial dynamics in the origin of the fiords. All these points are aside from the present purpose, which is to establish the reality and antiquity of the last glaciation capable of creating uniform and synchronous uninhabitable conditions over the faunal area and for the life-forms about to be discussed.

The concept of the Pleistocene in the northwest stems back to the bold reconnaissance, especially that of 1879 (1881), of G. M. Dawson, and if we consider the isolation of the field and the dates of his earlier writings, the explosive synthetic power and boundless scope of his work are among the brilliant phenomena of the history of his science. His first reaction to the evidences of recent and catastrophic activity which he saw as a pioneer, and recognized with the suddenly-liberated enthusiasm of the immediate followers of Agassiz, was to look for the key not only in glaciation and lacustrine inundation but in still more general submergence and marine invasion with current-borne ice. The many hundred miles of freshly glaciated conditions which he saw, through the length and breadth of the interior plateau, he suspected of being the work of ice carried by an arctic current which penetrated the Rockies, and it is a curious fact that it was not the absence of marine deposits but the narrow tortuousness of the Peace and Pine passes which had, when he summarized his ideas in 1881, persuaded him reluctantly to abandon marine submergence and turn to his previously-stated alternative,— the now familiar hypothesis of an ice-cap, initiated at a northern centre on the central plateau at a time and locality of maximum precipitation, spreading southward and westward, escaping into the Pacific and down the great southern valleys. He still envisioned immense lacustrine inundations, both in the southern valleys of British Columbia and connecting the present great lakes of the northern plateau, in which were laid down both the drift-fields of the Babine region and the white silt areas, northern and southern. He still was inclined to attribute much striation to floating ice, and harked back with uncertainty and regret to the marine hypothesis.

Since Dawson, and with the coming of the intensive locality investigations of the Canadian Geological Survey, usually tied up with gold discoveries or other economic factors, geologists have found little time for generalization, yet it cannot be said, with the exception of a usually implicit rather than expressed tendency to localize and reduce the lacustrine stage and attribute it to damming rather than subsidence, that the accumulation of detail has modified Dawson's final picture beyond recognition. R. A. Daly (1915) gives good reason based on general lack of correlative evidence, for doubting the amount of submergence and elevation Dawson required for his white silt lacustrine submergences.

It may be well to mention in passing an opposite extreme,—a tendency so rare as to be negligible, to consider the whole glaciation of the intermountain plateau as merely piedmont in character (*vide* Lobeck, 1939),—a concept born of the facile use of small scale maps and failure to comprehend the extent and character of the ground in question.

Working from north to south, there follow the principal instances of intensive geological research which deal in some degree with the late Pleistocene and Recent. It must be remembered that in almost all reports these periods are subordinated or neglected. Since Dawson, only in the work of W. A. Johnston has the Pleistocene formed a subject of primary interest.

THE INTERIOR

For the northern part of the interior plateau of British Columbia technical information is scant and depends for the most part on the works of Johnston (1925) and of F. A. Kerr (1925) on Dease Lake and the Cassiar, and on that of W. E. Cockfield (1925) on the area between Telegraph Creek and Atlin. Johnston finds the thickness of ice over Dease Lake at the maximum at least 4500 feet, or reaching some 6500 feet above sea level, with an average thickness over the district of 3000 feet. Predominant erosion by valley glaciation may be interpreted as indicating either a relatively short period of maximum glaciation or long stagnation of the mountain-hemmed ice-cap. The slightly-weathered drift of the highest levels, however, indicates its deposition during the last period of glaciation. The brief references to the Quaternary in the reports of Cockfield and of Kerr are concerned with the relative chronology of the glaciations and the last manifestations of active vulcanism.

More information is available for the central and north-central area. For the slopes of the Rockies we have the work of Kerr (1933, 9-29) on the Manson River and Slate Creek deposits, for those of the inner Coast Range that of Marshall (1924, 47-58; 1925, 141-151), for Whitesail, Tahtsa, and Eutsuk Lakes, that of Hanson (1924, 19-37) on Driftwood Creek, or A. H. Lang (1929, 62-91) on Owen Lake, and Dolmage (1924) on Chilko Lake and vicinity. Centering about the Cariboo goldfields there exists an especially rich collection of papers, including especially those of Johnston (1922, 168-187) on Cedar Creek, and of Johnston and Uglow (1926, 26-30) on the Barkerville deposits, in addition to Cockfield and Walker (1932, 76-131) on Quesnel Forks, Walker (1930, 125-153) on the Clearwater River and Foghorn Creek area, Davis (1929, 274-296) on the Clearwater Lake Area, and Hanson (1933, 30-48) on Willow River.

Almost without exception these accounts accept one or more complete coverages by continental ice as self-evident. Marshall determines an overridden altitude of 7100 on Chickamin Peak. Lang emphasizes the flatly-rounded ice-cap glaciation of the 7065-foot summit of Mt. Nadina and other lower peaks. Johnston finds a minimum of 6000 to 6200 feet about Barkerville approximately equal to the altitude of the highest present uplands. Hanson finds erratics up to 6700 feet and even high drift deposits on Mt. Tom near Beaver Pass reaching 5700, while Walker in the Clearwater region actually finds evidence of overridden summits as high as 8000 feet, and unquestionably regular southern movement over summits of 6600. Johnston's research leads him to believe in stagnant, mountain-hemmed ice conditions, leaving little striation. Others, not necessarily disagreeing, but working at lower altitudes, nearer the centre of such north and south movement as may have existed, find evidence of somewhat more movement (Cockfield and Walker; Hanson on Willow River). These accounts do not depend upon extensive lacustrine conditions or changes in elevation, in regard to which Johnston for this region professes frank ignorance. Johnston explicitly, and most other authors by implication, consider the just-ended stage of valley glaciation with its small, low-level moraines, as merely the closing phase of the last, or one and only, ice-cap coverage. Hanson alone, whether from the intrinsic peculiarities of his assignments or from some sceptical tendency in his interpretation of the evidence, holds back from the consensus of opinion. His Driftwood report is the only one which has been published on British Columbia which specifically states a failure to find evidence of the presence of a continental ice-sheet, while his interpretation of the Cariboo area involves two great glaciations, only the more remote of which is admitted to have been of a continuous character and to have overridden the uplands. He believes the second to have been persistently vallicolous in character.

The following generalizations from Johnston and from Johnston and Uglow have special bearing upon our problem.

1926.

In reference to the apparent interglacial levels of Eight-Mile Lake, near Barkerville:—

"There is no evidence of a true soil or vegetation of any kind on these surfaces nor in the interglacial gravels. . . . The lack of vegetation during the interglacial period seems to show that climatic conditions were not as favorable as at present."

1926.

"Pleistocene time is generally considered to have extended over at least a million years, so that during this extensive period very great erosion and deposition may have taken place. What seems to have happened, however, in Barkerville area is that during the greater part of the period the area, except possibly on the uplands, was actually protected from erosion by the ice sheet which was nearly stagnant."

1926.

"The glaciers probably retreated from the region only 10,000 or 15,000 years ago, and a small remnant of one of them still remains in the cirque basin on the north side of Mount Agnes."

1922.

"It is generally held that 10,000 to 20,000 years have elapsed since the disappearance of the glaciers of the Ice Age, and this is not sufficient time for much weathering or erosion of the bedrock."

Dolmage on the Chilko area draws a striking picture of the vicinity just south of some of the highest peaks in Canada. "Probably the most striking features of this part of the district are the immense glacial valleys which form a network of deep, broad trenches, cut to about the level of the plateau or deeper, and thus divide the range into a number of completely separated mountain blocks. These valleys vary in width from one to five miles.... All these valleys are believed to have been formed by glaciers which arose in the continental ice-sheet, and, as indicated by glacial striae, moved westerly through Tsunia, Nemaia, and Yohetta valleys, north through the southern parts and south through the northern parts of Taseko and Chilko valleys, and through Tatlayoko valley and on down Homathko River valley to Bute Inlet."

A large amount of historical research is available for the southern third of the interior of the Province, but very little attention has been paid to the Quaternary deposits and surfaces. Lying between the age of Dawson and the intensive investigations of economically important localities, Daly's extensive investigation (1912) of the international boundary remains the best summary of Pleistocene evidence. His basic conviction that "the Cordillera was ice-capped in that latest phase of the Pleistocene" was founded on the similarity in character and freshness of both rock and drift to that of areas of Wisconsin glaciation in the east. He was impressed by the profound distinction in character between the effects of the limited high altitude alpine glaciation and the otherwise universal effects of ice-capping. He reiterates his general agreement with Dawson. He believed "the middle part covered by a field 300 miles wide" which terminated in three great southerly lobes in the Chelan, the Columbia, and Puget Sound.

From east to west, he found the following coverage altitudes and conditions.

The Clark Range. Ice sheet glaciation up to 5500-6000 feet elevation.

Galton-MacDonald Group. Up to 7500 or more, with twelve peaks projecting as nunataks.

The Purcells. Over 7300 feet, with 5500 feet of actual ice-thickness over the Purcell Trench. The only nunataks were a very few peaks in the Yahk-McGillivray area which projected only a few hundred feet.

The Selkirks. Coverage to between 6500-7300 feet, with the summit ridge a single long nunatak.

The Columbia Mountain System and the Interior Plateaux of that latitude. Upper limit of sheet-ice about 7200 feet. He believed only two high points, Record Mt., with Old Glory Ridge, and Mt. St. Thomas, to have risen above the ice level between the Columbia and the Similkameen.

Okanagan Valley. Ice contours on Cathedral Peak and Park Mountain lie at about 7800 feet. Mt. Chopaka constituted a nunatak peak.

The Hozomeen. Sheet-ice contour at about 6800 feet.

The Skagit River Valley, as witnessed by its extreme ruggedness, did not bear a continuous ice-sheet in the last glaciation, but the Chilliwack and Fraser ice was confluent and at such elevations as to amount to part of the "Pacific Piedmont Glacier." He believed at least 3000 feet of ice to have overlain the Fraser flats.

The two latter areas should properly belong to the coast, but are included here rather than destroy the effect of this great survey.

Writing again, three years later (1915) after a reconnaissance of the Golden-Kamloops transect along the C.P.R., he finds little to recant or modify in his earlier conclusions, though he seems to be a little more anxious to make it clear that the crests of the Columbia and Selkirk ranges, though at maximum flood cut by many connecting "through-glaciers" connecting the various fractions of the great cap, none the less formed "ice-divides" of some extent. He also casts the strongest doubt, in the absence of correlative evidence, on the possibility of so great an uplift (2500 feet) as Dawson's own concept of the history of the white silts would require.

Of the many subsequent papers which touch on the Pleistocene and Recent of the southern interior few offer extensive treatments, but none challenge the general conviction of deep, late, and almost unbroken ice-capping. On the Rockies, S. J. Schofield (1915) finds that the second refrigeration covered the Cranbrook area with ice, from which very few peaks, such as Yahk Mountain, projected. J. F. Walker (1926) is one of the few recent writers to discuss Dawson's white silts, which he believes, in the Windermere area, to have been laid down under quiet water and not under ice, probably in a lake formed in the Purcell Trench "held in at the south by the terminal moraine and on the north by the glacier during recession." He adds, "During the glacial period the district was largely covered by ice. To what height continental glaciation affected the district is not known, for rapid disintegration has altered the whole area above timberline. Continental glaciation, however, reached an elevation of at least 7500 feet as indicated by erratics to be seen at that height. Some of the highest peaks may have reached above the ice, but it is probable that they had small glaciers on their slopes." J. F. Walker and M. F. Bancroft are brief but definite on the Lardeau. "During the glacial period the district was largely covered by ice. Some of the higher peaks perhaps stood above the ice, but from the evidence of erratics it is reasonably certain that the ridges and lower peaks were covered." C. W. Drysdale shows no less conviction in regard to the Rossland area. "During the Pleistocene a change to a cooler climate took place and snow accumulated in the Cassiar highlands on account of winter precipitation exceeding summer melting. Ice fields slowly gathered, deepened, and crept southward to form the Cordilleran ice-cap, which covered the whole region with the possible exception of a few high peaks outside the area in question, which stood as islands (nunataks) above the ice surface. The Cordilleran ice-cap modified only slightly the upland topography." He believes the best signs, valley-forms, and outwash materials, to be due to the last or Vashon refrigeration, and finds that great thicknesses of silts or sands accumulated in a glacial lake which covered the present confluence of Trail Creek and the Columbia. J. F. Walker's (1925, 222-229) Reconnaissance in the Purcell Range North of Brisco speaks briefly of the occupation of the Rocky Mountain Trench by a lake, heavily filled with glacial silts and gravel by lateral glacial streams, forming beds which were deeply terraced and dissected after the breaking of the dam. G. S. Hume's (1932) report on the Waterton Lakes-Flathead area considers that area as deeply covered by the Cordilleran ice-sheet, including the tops of the ranges. It describes the Crowsnest Valley east of Crowsnest Lake as flooded with the alluvium of an outwash plane as the subsequent and final valley glacier receded. Here at the time a long narrow lake was formed with water at least 300 feet above the present channel at Burns.

Next to westward is the treatment of the Okanagan by Cairnes (1931, 66-109), who finds unconsolidated deposits of glacial origin mantling the bedrock at least 900 feet above the present lake, and believes the lake-bed caused by the collapse of surface deposits with the melting of underlying ice, but makes no comment on the character of glacial or postglacial-lacustrine conditions.

For the inner slopes of the Coast Range more or less material on the Pleistocene and Recent is found, reading from north to south, in B. R. MacKay (1925) on the Hat Creek coal deposits, in Cairnes on the Yale and Similkameen areas (1922) and on the Coquihalla area (1924), and in H. S. Bostock (1929) on Nickel Plate Mountain near Hedley in the Similkameen. Cairnes finds, in both his areas, only one stage of ice-sheet glaciation, preceded by alpine glaciation, previous to which the mountains had reached a stage of early maturity, but none the less believes that in general the ice-caps had covered the northern Cascades more than once. He finds sheet-glaciation to have stopped rather sharply at 6500 feet, and of course that the debris was ultimately reassorted under water, giving rise to terraces, some of which are persistent. Bostock believes the 5600-5900 foot high gold deposits to have themselves been covered by not less than 3000 feet of ice. Glacial drift reaches the summit of the mountain. McKay merely records glacial drift in the Hat Creek valley and mantling the slopes, without precise records of height limits or other generalizations.

In general, the question of widespread inundation and the interesting problem of the widespread white silts have been carefully avoided. A notable exception to this is a paper by R. F. Flint (1935) which contains a fine survey and analysis of their occurrence in the Okanagan. Their faults and displacements are explained as due to their deposition by tributaries both alongside and upon the dwindling glaciers, with resultant long preservation of covered portions of the ice, and ultimate deposition resulting from final collapse. Without much bearing on the problem of completeness of maximum Vashon glaciation, the paper yet draws the following picture of the closing scene. "The features discussed in this paper imply that the last cover of Pleistocene ice in this district did not recede with a well-defined front, but wasted vertically downward, so as to expose the highlands while leaving long tongues and residual masses in such valleys as the Okanagan trench. This mode of wasting was clearly visualized by Daly in his discussion of the features of the trench at the Forty-Ninth Parallel, and is evident also southward to the southern limit of glaciation in northeastern Washington."

THE COAST

No inconsiderable amount of work has been carried out in the central or outer zones of the Coast Range on the present mainland and a very limited amount on Vancouver Island, the Queen Charlottes and in southeastern Alaska, but practically none, as concerns the Pleistocene and Recent, on the islands and headlands with which we are preoccupied, though Dolmage (1922) has a few remarks on the Pleistocene from Douglas Channel to the Alaska boundary, including Porcher and Tugwell islands. None the less, the general results of work on the coast are in no less perfect accord than in the case of the interior, and it is hardly thinkable that conclusions reached both in the north and south should not have equal application to the small area in question. On the coast, in connection with insular isolation, the question of changes of level, of elevation and depression of the land, becomes of equal importance to that of the age and uniformity of glaciation.

Although the general north-south order of localities will again be adhered to in this section, it may best be introduced by the conclusions of three papers of general application:—those of Kerr (1936a), Peacock (1935) and Buddington and Chapin (1929). Working back from the present or "Alpine Stage" Kerr finds three previous stages, the "Intense Alpine," when glaciers completely occupied the trans-range valleys, the

"Mountain Ice Sheet," when the Coast Range was buried in ice which moved east and west from the axis, and the "Continental Ice Sheet" when the ice, derived from the interior sheet, moved west across the whole range. He believes the Intense Alpine, at least, must have prevailed on the coast up to 9000 years ago and ice-sheet conditions over the whole range very shortly before. Shortly thereafter, on the other hand, roughly from 7000 to 3000 years ago, which parallels the figures of Antevs for Sweden, a warm period is believed to have prevailed with a great elevation of sea level, which appears to have stood between 400 and 600 feet higher than the present about 4500 years ago and reached its present level about 2500 years ago. This again agrees with a statement of Antevs that the land rose 600 feet within 2000 years after the retreat of the ice. Much of the evidence for these changes is concrete and spectacular. During the period assigned for the warm interval the sea certainly reached the Great Glacier on the Stikine, as the latter carries sea-shells and the wood of large trees where now is ice and fresh water only. Similarly the annual outbursts of dammed waters from beneath Talsekwe Glacier in the Taku district have brought forth fragments of mud containing sea-shells, in 1932, and alder stumps and mosses in 1922, all four hundred feet or more above sea level. There is abundant evidence below the present snouts of many glaciers of a subsequent advance. Kerr chooses in particular the glacier of Craig valley, tributary to the Iskut. Time estimates for the series of recessional moraines and the growth of their present vegetation indicate that the beginning of the retreat took place about 1000 years ago. Allowing 500 years for the previous advance gives something in the neighborhood of 1500 years for the whole episode. Kerr is inclined to attach credit to the Indian legend of an ice bridge over the Stikine at Great Glacier, and believes from local data that it may have existed 500 years ago. The history of the snout of that glacier since 1860 has been made up of minor oscillations, not the continuous retreat so many British Columbia glaciers suggest. It is to be noted in passing that Schofield and Hanson (1922) also find marine deposits to a height of 400 feet in the valley of Salmon River at the head of Portland Canal, and conclude that the land must have been depressed to that extent "following the maximum of glaciation."

Peacock finds the late Pliocene coast line well below the present 100-fathom mark and that the present coast line is the result of Pleistocene and Recent erosion combined with movements resulting in a net subsidence of some 1000 feet of an immaturely dissected mountain belt. We follow his story farther back into the geological past to make clear his idea of recent emergence, which he apparently suspects of being somewhat later than do other investigators. To quote, "As the latest proved movement has been an intermittent post-Glacial uplift of 600 feet, it follows that the actual subsidence amounted to about 1600 feet and that it occurred in late-Glacial or early post-Glacial time."

The author appears to entertain no doubt of the existence of an overriding ice-sheet, though he doubts its prime importance in the construction of the present fiords.

"This [600 foot rise] is attested by several well-defined post-glacial beaches now at that altitude in widely separated parts of the coastland."

"Within the narrow confines of the fiords these deltas are advancing rapidly, some of them scores of feet since 1900; thus, the inhospitable tide-water canyons must soon be filled with detritus and converted into fertile flat-floored valleys. If no further subsidence occurs the Island Fringe will regain connection with the Mainland Range; gradually the elaborate fretwork of the mainland fiord-coast will vanish; slowly the Intermont Valley Belt itself will be filled to sea level; and finally the Island Ranges will again be the bulwarks of the continent, standing as residual masses over a littoral with the simple outline of maturity." Indeed, supposing time and environmental stability to be conditions of the sharpening of differentiae and the slow progress toward "specificity" the populations described in the ensuing chapters stand singularly small hope of such an undisturbed future. The picture just drawn by Peacock, while favorable to the persistence of life, involves unlimited confusion and recombination of forms. But the probability of less favorable change, not too far distant for forethought as to the human race and its projects, is very great. The likelihood of the return of the ice, as it has returned before, is not a matter of infinite remoteness. Likewise F. A. Kerr (1936b), speaking of recent and contemporary vulcanism on the northern Coast Range, says "There appears to be no reason for believing that the disturbed conditions which have prevailed for so long in the Cordilleran region are at an end. It is only a matter of time, probably a short time, until vulcanism and earthquakes will again disturb the present temporary calm."

Buddington and Chapin (1929) remark, "During the Pleistocene epoch all the valleys and most of the mountains and the islands were buried under an ice-sheet that extended across the whole region to the Pacific Ocean. During the period of maximum flooding ice to the depth of a mile or so must have flowed out through those parts of the mainland valleys that now constitute fiords." They find many local elevations for the surface of the maximum sheet in southeastern Alaska, from 4500 to 6000 feet,—at Eagle River alone only 3400 feet. Below these altitudes the mountains are smoothed, above them "serrate, pinnacled, and frost-riven." Even though the island ice-depths naturally decrease from those on the mainland, all their surface levels are sufficient to cover all or the vast majority of our island peaks, a circumstance confirmed by our own layman's observation during years of climbing. Buddington and Chapin find a general southwesterly flow, with local variations. After a long discussion of shore-line benches, they go on to say, "That recent uplift to the amount of 600 feet has taken place in this region is indicated by deposits of post-glacial clay, sand, and gravel, containing a marine fauna, which have been found up to this height. . . . Benches and terraces of fossiliferous marine gravel, sand, and clay, are found locally at altitudes of up to 600 feet throughout southeastern Alaska." Many such are listed. The general lack of glacial deposits on land is accounted for by three factors:—(1) submergence of glacial fronts at the time of last recession, (2) the characteristic steepness of the fiord walls, and (3) the rapid erosion rate. Numerous drowned moraines are, however, listed.

Martin and Williams, in their study of Lynn Canal (1924), contribute little of pertinent value except the statement that "one of the latest, if not the latest, earth movements here" was an uplift of from 60 to 200 feet.

Before leaving southeastern Alaska notice should be taken of G. K. Gilbert's (1901) discussion of the glaciers and glaciation of the region in the Harriman series, though it has in considerable degree been superseded. It appeared to him that the whole region had been "deeply buried in Pleistocene ice," as he remarks in reference to Annette Island. He appears to take this for granted for the whole coast, though he draws no specific distinction between continental and other types of glaciation. None the less he defines rounded summits as having been under ice which he finds to have reached sundry elevations from 3000 to 5000 feet. These he says indicate the depth of "the confluent ice of the Pleistocene," which he believed reached 6000 feet at a maximum. Finally he states his complete agreement with Dawson as to the existence of an ice sheet, though with many uncovered nunataks.

Hanson (1932) in his discussion of Tide Lake, some 40 miles north of Stewart, says, "As the position of the ice-front, though it has oscillated backward and forward from time to time, depends upon the present climatic condition, the lake probably presisted ever since these conditions have prevailed. This period as generally held may be 2000 years or more." It is greatly to be hoped, for the sake of some definite knowledge of even that brief period of the immediate past, that Hanson's suggestion of work on the remarkably varved clays of Tide Lake will soon bear fruit.

It is a far cry from southeastern Alaska to the general latitudes of southern Vancouver Island and Vancouver, yet little research has been carried out between the two.

Dolmage (1922), as has been observed, finds true boulder clays and other deposits of unquestionable Pleistocene origin, laid down in salt water and now elevated to not less than 200 feet above sea level on Porcher Island, Granby Bay, Petrel Channel, Tugwell Island and alongshore toward Port Simpson. His later work (1925), on a transect of the Coast Range from Tatla Lake to Bella Coola, unfortunately neglects the surface deposits except to note that the great drift areas in the eastern part of the area overlie the volcanic lavas of the late Tertiary or Pleistocene.

Technical information on the neighborhood of the Skeena depends largely on the work of Hanson (1922, 1923, 1924, 1925), who, as in his work on the interior, refrains from comment on the general aspects of ice-sheet glaciation and gives only briefest mention to occurrences of drift deposits and erratics, without elevations.

Although Dawson himself was as well aware of the heavy glaciation of Hardy Bay and the Masterman Islands as he was of that of the Gnarled Islands northward in Dixon entrance, the only modern or intensive work in the broad area of Queen Charlotte Sound is that of Gunning (1929), on the Nimpkish-Quatsino area in northern Vancouver Island, who again found little time for the evidence of the Pleistocene, though such details as he gives fit perfectly into the picture which has already been developed. "There can be no doubt," he says, "that the region was heavily glaciated. Bedrock, where naturally or artifically exposed, is fresh or very slightly oxidized and at time retains the markings of glacial erosion. The upper outcrops of the Caledonia group, about 1100 feet above sea level are deeply striated and grooved and parts of the magnetite have been well polished by passing ice." Elsewhere higher levels are briefly mentioned: "Glacial drift is abundant and in places reaches a depth of 300 feet in the valley bottoms. It also mantles the sides of the valleys to altitudes of more than 5000 feet." No precise interpretation as between ice-cap and valley glaciation is expressed, but the former appears to be implicit in the data. No indication of direction of flow or data on changes of sea level are included. J. D. Mackenzie (1922, 51-57) devotes a few paragraphs to the surface conditions of the Alberni area, to the effect that stratified and waterlain glacial tills are the principal surface deposits above the 400 foot contour throughout the area. These were laid down in lakes caused by glacial damming or into estuaries when the land stood higher than at present.

Dolmage (1920) refers very briefly to the glacial tills of the west coast of Vancouver Island between Barkley and Quatsino sounds. "All that can be said of this formation is that it appears to be of marine origin and of so recent a date that it shows no sign whatever of consolidation or folding. It has been uplifted so recently that the streams have as yet cut into it only to a limited extent."

To continue with Vancouver Island, though on the basis of observations of the southern areas, C. H. Clapp (1912, 51) says in part:

"During the glacial period Vancouver Island was covered by an ice-cap, and valley glaciers flowed west into the Pacific Ocean and east into the piedmont glacier which flowed southward through the Strait of Georgia, overriding the southeastern lowland of Vancouver Island, and thence westward to the Pacific Ocean through the Strait of Juan de Fuca."

"On the retreat of the earliest and largest glaciers the land stood some 200 to 400 feet lower than at present." He goes on to outline an intervening period of deposition, followed by a second, less intense, glaciation, followed in turn by the present uplift.

Two years later (1914), working on the Nanaimo area, he again attributes the most spectacular evidences of glaciation to the Admiralty, or earlier, of two advances, and considers the Vashon less intense, though followed, as fossil-beds in the Nanaimo vicinity, on Texada Island, and near Vancouver testify, by an elevation of not less than 400 feet. These reservations as to southern Vancouver Island are of the greatest interest in regard to evidences of more ancient and deep-seated endemism of vertebrate animals in that area, as discussed elsewhere in the present paper.

Turning toward the southern mainland and the islands of the Gulf of Georgia, we again find that the essentials had been first and perhaps best seized upon by Dawson's (1881) eager intuition. Respectively above and below the narrows he perceived the obvious facts that Cormorant Island to the north and the Harwood-Mary-Hernando-Savary group to the south represented fragments of moraines from the retreat of the great residual glaciers as they withdrew into such inlets as Knight and Bute. There exists no essential discrepancy between this vision and the conclusions of McConnell (1914) in connection with his research on the nearby but ancient and rock-cored Texada Island, who says of the same deposits, "It is probable that after the first retreat of the ice, the wide basin occupied by the gulf was silted up to a height of about 200 feet above the present sea level. Subsequently the whole widespread sheet of soft sediments, with the exception of a few sheltered patches, was destroyed.

"The upper boulder clay occurs overlying the interglacial beds on Harwood Island and north of Gillies Bay. . . . The upper boulder clay is a typical ground moraine laid down on land. After or during its deposition the island was depressed and the low-lying portions, up to a height of about 500 feet above the present sea level, were submerged. This is shown by occasional patches of gravels and beach sands up to that elevation. Marine shells were shown near the Lake mine at a height of 380 feet, near the Sentinel claim at a height of 424 feet above sea level. . . . After the final retreat of the ice the land rose to its present position, and changes in level ceased. Occasional rock beaches cut by the waves in hard quartz diorite and limestone show that the island [Texada] has remained at the same elevation for a long period. The changes must have been gradual without prolonged breaks, as no well-marked elevated rock-cut terraces were observed on the island."

He finally adds, "At the time of maximum glaciation, the island was entirely submerged in ice moving in a southeasterly direction."

Harking back for a moment to Dawson's discussion of the same area, we find him unafraid to generalize.

"In the fiords penetrating the coast of the mainland of British Columbia and channels penetrating between the numerous islands lying off it, from the southern extremity of Alaska to the north of Vancouver Island marks of the passage of glacier ice are to be found wherever the rocks are unweathered. The marks are generally in strict conformity with the direction of the passages, which it is evident must have been filled with ice moving in the main seaward from the coast ranges, in which many small glaciers are still found. Whether at any time the supply of ice has been so great as to form a confluent mass flowing toward the sea, at right angles to the general direction of the mountains and without regard to the smaller features of the surface, has not been definitely ascertained, but it is highly probable that this happened."

On the extreme southern mainland we again encounter a rich aggregate of modern research. Following the work of Bayly Willis somewhat south of our area and the separation of the Vashon from the Admiralty tills, first Burwash (1918) and later Johnston (1923) worked on the Fraser delta and neighborhood of Vancouver, while farther inland on or near the height of land in the same general latitude Cairnes made investigations of the Pemberton area (1924) and of Silver Creek and the Skagit and Similkameen rivers (1923).

Burwash's general concept is that "since the Vashon overrode the greater part of the range as a continuous ice-sheet, with a few projecting nunataks, it is probable that the [older] Admiralty did so too." He found the upper limit of the Vashon on Mt. Strahan at 5000 feet, so that the descending ice-sheet from the main range was here, to the bottom of Howe Sound, some 6000 feet thick. He goes on to reconstruct first post-glacial conditions: "After the recession of the ice the prevailing condition must have been that of a broad estuary which covered the lowland, while fiords covered the mountain valleys. The deposition of the sediments must have occupied some time before upward-movement brought the sediments up to sea level." At the close of the Vashon the sea is supposed to have been 760, perhaps 800 feet, higher than now. Subsequent resting stages, during the rise, are marked by terraces.

Johnston also finds that during the final retreat the delta lay beneath the sea, but his figures for the subsequent rise, at least 650 feet, are a trifle more conservative than those of Burwash. Johnston's figure is based on the Burrard Inlet valley-mouth terraces, and shell-beds elsewhere in the area. Behind this final rise he visualized two or three advances and retreats with oscillations of elevation, leading back to a pre-glacial elevation of the land some 2000 feet higher than the present. Since he believed the post-glacial elevation to have been only some 250 feet at Victoria and 400 feet at Nanaimo, he finds the indicated uplift to increase in the direction of recession, an interesting suggestion not developed by other authors. He agrees with McConnell and others on late post-glacial stability. "The Recent deposits have been formed during the past few thousand years, during which time the relationship of sea and land has been nearly or quite stable."

At nearby Britannia Beach, on Howe Sound, H. T. James finds that "during the Ice age Britannia map-area was completely covered by a mantle of ice up to an elevation of 5500 feet at least, for beautiful striae, deep glacial grooves, and large erratic boulders are found along the summit of Goat Mountain at this elevation. The Sawtooth peaks, due east of Goat Mountain, are a group of needle-like peaks rising to an elevation of 6700 feet, and it is possible that they projected above the ice-cap and are now sharp peaks because they were not smoothed off by the ice. . . . The continental ice-sheet moved southerly parallel to Howe Sound, and directly across Goat Mountain and Britannia ridge. . . . During recent time the whole area has been subjected to uplift and erosion. The amount of uplift in this area is at least 500 feet."

At Pemberton, on the height of land, Cairnes (1924a) says in part: "The entire area has been glaciated to a height of at least 7000 feet. With the possible exception of the highest peaks the entire area was covered by an ice-sheet whose movement on the higher ridges seems to have been southerly or southwesterly."

On Silver Creek and the upper Skagit the same author (1923) repeats in effect all that has been quoted from his work on the Yale and Coquihalla as to the prevalence and altitude of ice-sheet glaciation.

It is not the intention of the writers to intrude lay opinion into this consensus of expert evidence. Yet if, after reviewing what has been brought together, the reader still finds himself in doubt of the actuality of one or more breaks in the continuity of most vertebrate life over an overwhelming fraction of the area of British Columbia, the last ending gradually during the last few thousand years, we can offer no better remedy to the sceptic than to go and see for himself. The evidence in the field, once intelligently seen, is more spectacular and more convincing than anything in print. The results of almost a quarter-century of climbing and wilderness travel in British Columbia and southeastern Alaska have served in some degree to draw into perspective the scattered localities which have been intensively studied and to produce some dim synthetic vision of the phenomena, such as harsh technicalities fail to convey.

On the area under discussion, on the middle coast, the character of the bedrock reaches a maximum of significance. Gunning (1929), almost alone, speaks of the lack of oxidation of the polished rock of northern Vancouver Island, while Walker (1926) and others mention the obliterative disintegration existing above timberline in the interior. Yet this slight and difficult character is responsible for a huge difference in the spontaneous impressions conveyed by the exposed areas of the two regions. No glaciated upland of the interior gives the impression of brilliant newness or of the very rapid yet still incipient process of first coverage by soil and vegetation, which is everywhere plainly visible on the islands except on the timbered inner slopes, the winners in the race for fertility. There is nothing in the interior in the least recalling the long flat ridge-summits of Princess Royal Island, like new-built Roman roads. Yet when one asks just why this impression is so strong, the answer is difficult until this very matter of surface texture comes to mind.

So much of the more obvious evidence for the coast lies in the fresh-cut rock, for the interior in the drift, till, and silt, that grounds for age comparison, for comparative times or speeds of recession from the west and from the south, are lacking. It would be easy to imagine, were temperature instead of the precipitation-balance the leading factor, that the coast, with its warm current and winds, might have been more quickly reclaimed for the higher forms of plant and animal life. Yet the impression, in spite of the slightness of comparative evidence, is subtly otherwise.

Finally, though it is not difficult, whether on the ground or from the results of research, to demonstrate the recent ice-coverage of almost any fraction of the British Columbia region, the most insidious criticism of the hypothesis *in its biological implications* remains unanswered. This is the allegation that, while the phenomenon in its broad sense is proved, the local estimates of elapsed time cannot be so perfect as to prove synchrony of the latest glaciations,—to prove, that is, that at any given moment throughout the region coverage was so uniform as to displace, everywhere and at once, the vast majority of present forms of mobile vertebrate life. Such a consideration gains weight from the fact that on present heavily-glaciated areas life, both plant and animal, crowds up to the edges of the lower ice-tongues with surprising hardihood.

That such an objection is academic, born of reflection upon theoretical possibilities rather than suggested by the evidence, does not constitute an effective reply. To say that anyone who spends the requisite part of a lifetime in intimate contact with rock and till throughout the region must derive an overwhelming sense of the equality of the geologic indications does not satisfy the critic who is unable to do so.

The objection for the province as a whole is hard to answer, but less hard for the Coast Range strip with which we are mainly concerned. Here evidence of glacial uniformity and synchrony does, in a broad sense, exist. Such evidence must depend upon the present degree of uniformity of post-ice-cap conditions which prevail to latitudes far south of Queen Charlotte's Sound, and upon the uniform freshness of marginal ice-sign extending outward with unbroken continuity from the present ice.

There is very little appreciation of the long step backwards into immediate post-ice-cap conditions which one takes on entering the valleys from Portland Canal north to the Stikine and beyond. This applies to low elevations reaching as far south as 56°N. It is comparable neither geologically, climatically, nor biologically to the more permanent sub-arctic conditions beyond Lynn Canal, or those of isolated spots such as the Columbian Ice-field, with their high altitudes and low temperatures. At the head of Portland Canal one may stand on any of the low peaks, such as those at the head of Texas Creek, and look down upon the floors of every receding valley-system broadly filled with the white ice of glaciers whose snouts reach to within a very few miles and a few hundred feet of elevation from salt water. In addition, not only are the higher truncated summits and elevated pockets full of ice, as they are far to southward, but low, rounded, isolated, summits, such as those at the head of Salmon Creek Glacier, may be covered by rounded and detached ice-fields. These are definite remnants of an ice-sheet. Such summits would not have been suitable for later or independent accumulation.

It is true that south of Portland canal there occurs a more or less perceptible change. The distance in time from immediate post-ice-cap conditions to our own early interglacial lengthens apace. But the difference is of slight degree and not at all of a kind. To the south the glaciers withdraw, on the average, both farther and higher from sea-level, and the ice-fields are restricted to areas more favorable to their preservation or occasional growth.

These conditions are greatly underestimated, for the simple reason that the few well-known spots are rare and exceptional niches favorable to human life and travel. It is, for instance, quite possible to spend a lifetime in the Bella Coola valley aware only of the high valley-glaciers on the inner peaks. Yet a day's climb from the beach at the head of North Bentinck Arm brings one over the visible rim into a new world of intermittent ice-fields, the waters of which periodically wipe out attempts at settlement in that remarkable but somewhat deceptive valley. The same is true of successive drainages far to southward.

Thus conditions over the broad, little-known, average level are essentially uniform in the long back-step toward total glaciation which they represent. Minute points of extreme advancement like the Bella Coola and parts of the Skeena valleys, cutting through the heart of a glacial environment, are in no sense different in their immediate history. There is a small, sharp break in the conditions of today, but none in the indications of yesterday. The head of North Bentinck Arm exhibits, hidden in the timber of its northern corner, the most startingly fresh-cut and spectacular rock sculpture that has been seen in years of exploration of the coast.

Considering such degree of uniformity at the glaciated levels of the present day in conjunction with the still greater uniformity of marginal sign, it is difficult to think of the last coverage as anything but a unified phenomenon, concurrent throughout in space and time. North of Portland Canal it would seem to the casual observer at least that any considerable change favoring ice-accumulation must narrow the timbered zones to the disappearing point, if only by local contribution, leaving out of consideration the historical factor of continuity with vast streams of interior ice. The evidence of such recent climatic change is overwhelming. The timbered zones show fresh and universal evidence of recent coverage. The chance that such degrees of change within the limited area could have been intermittent or localized is almost nil. Here at least it is a captious critic who fails to see the last coverage as synchronous and uniform.

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SECTION II

TOPOGRAPHY, CLIMATE, AND FLORA, THE SALT-WATER BARRIERS

The drowned piedmont area and the western skirt of the coast range, the outer mainland and the island fringe of northern British Columbia, are strange examples of monotonous ecological uniformity covering great topographical diversity. When the bio-geographer's work is done, and the last plant and animal population mapped, from the barest glaciated peak to the flattest offshore reef or the most sunless and saturated gorge, it is safe to say that, leaving out the organisms that are tied to salt water, a scant handful will be found that may not occur almost anywhere between the extremes of topographical diversity. If a few truly alpine plants, such as the false heathers, refuse quite to exchange the mountain tops for the pseudo-alpine, moss-rimmed rock-pans of the outer islands, the vast majority, such, for instance, as *Loiseleuria procumbens* Desv., do so with unexampled success, and the most reluctant alpines are in point of fact led downward over the tracks of slides or glaciated declivities to altitudes only a few feet higher. If, in a tangible and visible sense, the universal carpet of deep moss binds all herbaceous associations into one, the immense rainfall, the moist undrying winds and grey skies, do so not less effectively. With such superabundance of moisture everywhere that "muskeg" bogs of sphagnums and grasses form on steep mountain slopes, much of the distinction between sun and shade, nakedness and cover, good drainage and bad, forest and open, disappear. The best-drained and best-insolated areas can maintain plants better suited, under normal conditions, to the dripping forest, while in the darkest and wettest gorges it is a rare herb indeed that can survive, and the black hemlock forest rises from a gloomy understory of darkness, slime, and decay.

The great axial peaks of the Coast Range, which above Knight Inlet reach some 13,000 feet, lie from forty to eighty miles east of the outermost headlands, and well beyond the heads of the longest fiords. The latter are divided from another by subsidiary spur ranges. These step gradually downward into the sea, and the outermost peaks are the innermost islands. Pitt, Gribble, Princess Royal, King, with elevations of from 2000 to 3000 feet, are precipitous, carved with scores of hanging valleys and cirques, gleaming with tarns and cataracts, but bearing practically no permanent ice. On the rows of opposite peaks to landward glacicrets occur, and increase rapidly eastward, but heavy alpine glaciation hardly begins until the heads of the inlets are passed.

On the next zone of islands to seaward, or on the outer shores of the zone just mentioned, there occurs the first abrupt break in the nature of the topography, the transition from precipitous foothills to a rough piedmont plateau. Swindle, Princess Royal, Campania, and Pitt, are notably less steeep on their seaward aspects. Conversely, Calvert, Hecate, the Hunters, Aristazabal, are flat islands with one or two dwindling peaks on their eastern shores. Finally Price, the Estevans, the Bardswells, the Moores, and Goose, are nearly flat and their gently-sloping plane is marked for miles to seaward by innumerable wet or dry reefs.

Much of the strange character of the country and its seas, and the extreme youth of many of the islands, is attributable to the mere geological coincidence that the present sea level almost exactly corresponds with that of the flat piedmont shelf. To this is due the elaborate dis-

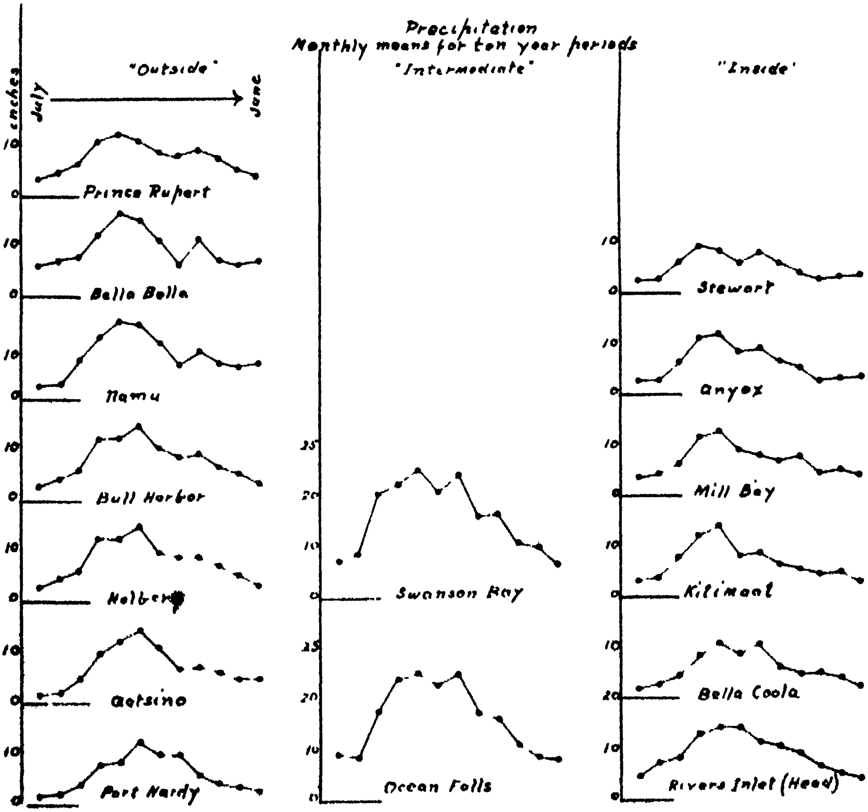

FIG. 1.

section of such island groups as the Bardswells, the powerful and infinitely complex tidal system, the nook-shotten character of the outer coast lines, the reef-strewn, unnavigable, and often unfishable offshore waters. These particularly vicious areas, from a sailor's viewpoint, are explained by the fact that the plateau in question, whether below or above water, while remaining between narrow limits of vertical elevation, is by no means smooth, but characterized everywhere by small, abrupt hilliness. In some places, as on the southern part of Price Island and various parts of Calvert, the base level is densely studded with peculiar low, steep, rock nubbles, undoubtedly the product of ice action but, as far as we know, never described by a geologist. These may make a mile's travel a hard half-day's work. Only back of Cape Caution, in Queen Charlotte's

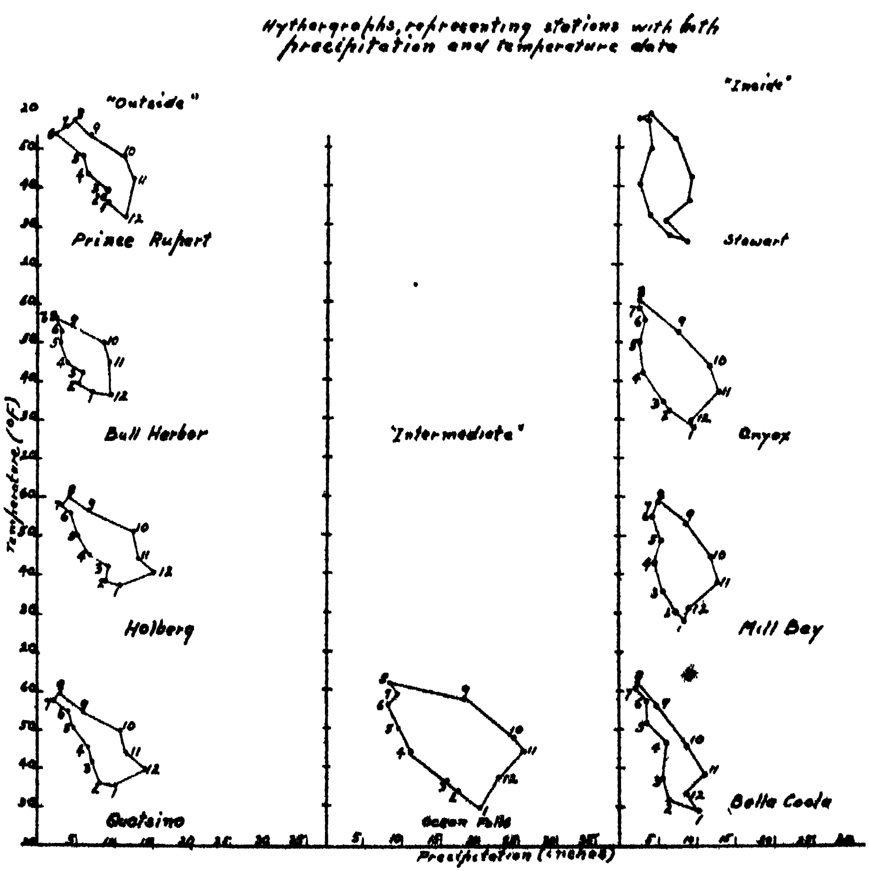

FIG. 2.

Sound, does the mainland fall to the plateau level and assume this character before being cut off by one or more channels of the sea.

Climatic factors, no less peculiar than those of topography and geological history, are not less important in the creation of the strange environment to which the populations in question are confined. The high degree of ecological uniformity of which we have spoken does not mean that zones of temperature and rainfall, correlating with those of elevation and longitude (rather than latitude) do not exist. It is rather that even the lowest zones are so lavishly watered that further excess has little effect.

Of temperature on the "outside" north of Vancouver Island, we know very little. In their synoptic monthly means the Canadian Weather Service shows sharp declines in its "North Coast" group of stations as compared to Northwestern Vancouver Island, and a still further decline for the data assembled near the mouths of the Skeena and Naas. But this involves the illogical grouping of data on the basis of mere latitude, while the significant distinction lies between the "inside" and the "outside" north-south zones. Thus extreme northwest Vancouver Island, which is a mild, low shore, washed by the Japan Current, is compared with more northern groups which include the ice-hung inlet-heads. In point of fact. on the true "outside" there is probably little temperature change over the length of our area, i.e., from Queen Charlotte Sound to Dixon entrance. On the inside, also, successive, roughly parallel, north-south zones of similar temperature will, eventually, be demonstrated. Beyond Dixon entrance at the inlet heads, where the great lowland glaciers begin, there is a true *latitudinal* change.

As to the precipitation, a sound concept of the situation involves the understanding of three very irregular but parallel coastwise zones,—an outermost, covering the piedmont plateau islands, with a relatively low figure, a rain-sodden and snow-smothered intermediate, whose outer edge follows the outermost peaks, island or insular, which exceed 2000 feet, and a relatively dry inner zone, lying beyond the point of most active dehydration of the on-shore winds. This last is distinctly shown by stations at the heads of inlets, where the precipitation is again reduced to the rough equivalent of the "outside." It must be remembered that we have no data whatever for the true outermost shorelines, and that the excellent summer climate of that narrow strip is officially quite unknown.

Both in Figure 2 and Figure 3 the graphs are arranged in three groups, "outside," "intermediate," and "inside." The division is somewhat casual and arbitrary, and based on topography rather than longitude. Thus Swanson Bay, which, with Ocean Falls, represents the true intermediate, is so placed in spite of its location on the outer face of a headland, because it lies in the very shadow of the highest summits of Princess Royal Island, while Quatsino, Port Hardy, and Namu are taken as "outside" because the considerable land-masses to westward are too low, with the exception of the single small and isolated peak on Calvert Island, to have any considerable effect on the moisture-laden air. Actually Mill Bay, Anyox, and Stewart lie north of Dixon entrance, while the latter is close to the Chickamin, Salmon, and other great lowland glaciers, and beyond our precise physical complex. In the great dearth of data, however, they serve well to illustrate the narrowness, from west to east, of the area of extreme precipitation.

The nature of the forestation may best be understood by picturing to one's self a second, or littoral, timberline, in addition to the usual altitudinal one, though, as has been said, the two may almost meet. As seen from the air or the outermost mountain peaks, the broad yellow zone of more or less continuous muskeg, cut by tortuous bands of timber and dotted with pans of naked rock, runs back from the outer shores of the outer islands roughly to the first considerable "height of land," whether on the same island or the next to landward, so that most inner slopes are timbered. The outer slopes of the inner islands, as seen horizontally, show solid green timber, but from above often show about half and half, with the ridge tops and lower areas of impeded drainage open moss and grass.

On the headland mountains the degree of continuity of timber cover, considering the smooth precipitous underlying rock, the thinness and saturation of the soil, is extraordinary, yet whole mountain slopes of naked rock are not uncommon. Actually, the combination of steep glaciated rock and an incredibly thin, muddy, purely humic soil, bearing surprisingly heavy timber, makes possible the peculiar phenomenon of the sweeping earth-avalanche, to be described in an ensuing section, which probable has played so great a part in the colonization of the islands. It is hardly too much to say, in the meanwhile, that along the steeper shorelines, around the low hanging-valley lakes and the cirques, forestation represents a state of equilibrium between the deposition of soil and its tendency to slide. Climbing in such areas includes an unfamiliar risk,—that of attempting too-vertical surfaces, deceived by their great load of moss, fern, and trees, with the result that some fraction may let go and cascade over a cliff below. More than one life has been lost in this way.

The better forestation of the more mountainous, more "inside" areas, is not due to greater depth of soil or better shelter, but to better drainage. Therefore it does not indicate greater age in the sense of longer freedom from ice-coverage. The nakedness of the great outer flats of Banks or Aristazabal or southern Calvert is a necessary consequence of the existence of innumerable, well-nigh continuously connected, glacial depressions in solid rock, filled with water and representing every stage of slow filling with alluvium and peat. Here many feet,—perhaps many yards—of soil must be laid down before its surface becomes fit for forest growth, while on a mountain side a forest may grow on from six inches to a foot of half-rotted matter. Contrary to a general impression, outside seafront *exposure* does not prevent the growth even of large Sitka spruce. A narrow zone above the outer beaches, as well as along small, sharp declivities in the interior, as along banks of streams, is usually well-drained, and hence forested. Almost invariably, when an outside landing is made, it is necessary to break through a few yards of forest in order to reach the "open going" of the interior. The splendid small stands of spruce which may occur along such strips, as at Borrowman Harbor on northwestern Aristazabal, minimize the probability of the importance of exposure in the explanation of outside conditions in general. The tiny islets of Queen Charlotte's Sound are exquisite miniature examples of this rule. Table Island, which is perfectly flat, wears an unbroken necklace of timber some fifty yards thick, while its whole interior is muskeg, punctuated with dwarfed grey skeletons of scrub-like *Thuja*, or *Chamaecyparis*, which have failed to survive. On the contrary, Pine, Egg, and False Egg, which are high and rounded, bear crowns of timber, as indeed do many of the wildest offshore rocks of the Walker, Gordon, Moore, and other groups, sometimes down to one or two trees. Goose Island, seen from the sea, looks heavily timbered. Actually it is a large sphagnum-bog, ringed with trees, often with fine spruce.

Exactly the same considerations, as will be shown later, apply to the location of the present shoreline metropolis of island *Peromyscus*. The elevation and solidification of the peat, the deposition and encroachment of soil about the edges of the bare rock, is obviously progressing very rapidly. The relations of muskeg, forest and rock represent a moment of historical equilibrium. If the present land-elevations and areas remain constant for even the few hundred years that the growth rings of shoreline trees show them to have in the past (we have counted such yellow-cedar and spruce with over three hundred rings) considerable increase of "dry land" and forest is to be expected, with a correspondingly increased area suitable for *Peromyscus*. The same argument in reverse adds to the probability of the youth and recent increase in size of the present populations. Not that dark coast forest is in itself a good *Peromyscus* habitat, but that general increase in literally "dry land" will bring with it increased areas of forest edge and habitats analogous to those occupied elsewhere.

The forest, through what we have described as the outer and intermediate climatic zones, is generally too wet to burn, but the stronger sunshine towards the heads of the inlets makes occasional fire possible. Yet, at some date too ancient for Indian tribal memory, the gnarled scrub of the whole north end of Aristazabal was swept by fire, and the tortured, steel-hard, grey ghosts still hold faint vestiges of charcoal in their crevices. In far more recent time a few acres of heavy timber on the southeast corner of Princess Royal, near the outer end of Meyer Pass, was burnt. These are extraordinary occurrences.

The formulas for the distribution of the handful of forest trees are not difficult. Where the soil is either too poor, too rocky, or too wet for anything else, place a marginal sprinkling of the coast "jackpine," *Pinus contorta*. Under the former conditions it is spindling or scrubby, with a predominance of the peculiar pompon shape. In the latter, at the edge of deep bogs, it may be a magnificent tree, of pure candle-flame shape in youth. At the head of the "First Lake" in the interior of southern Calvert there are specimens of great height with thirty-six inch butt diameters. On heavily timbered slopes on the outer hills *Thuja plicata*, passing in some degree into *Chamaecyparis* at higher elevations, prevails with the best insolation, *Tsuga heterophylla* with the worst. *Tsuga mertensiana*, to well beyond Dixon entrance, is still restricted to high elevations and the intermediate and inner zones. The superb Sitka spruce, in any considerable size or quantity, is practically restricted to the tiny deltas of the innumerable stream mouths, and, with *Abies amabilis*, to fortunate south-facing lower slopes and rich pockets. In the two outer zones few spots have been found to carry timber of commercial value, and those few rarely with feasible booming grounds. *Pseudotsuga*, on the outside, stops with Vancouver Island. Farther north, it reaches salt water only at inlet heads, notably at Bella Coola, and plays no part in our picture. *Taxus* appears occasionally on all low elevations, and may become quite abundant above the beaches of the inner shores of the outer islands. Most island muskegs, streams, lakes, and beaches, are margined with *Alnus sitchensis* (Regel) Sarg., which attains immense size, while *A. rubra* Bong. evidently reaches the inlet heads and *A. oregana* Nutt. the northern end of Vancouver Island. Probably one of the factors which contribute to the distinctive character of the landscape is the absence of the softening effect of willow. This is absent from the islands, unless as a great rarity, uncommon on the outer headlands, and only begins to play its usual part in the northern scene on the upper inlets. Dr. Carleton Ball has kindly identified specimens from Swanson Bay, Green Inlet Lagoon, and Khutze Inlet, off Graham Reach, as *Salix sitchensis* Sanson, and three species from Bella Coola as *lasiandra* Benth., *Scouleri* Anders., and *sitchensis* Sanson. The fringing islands of Vancouver Island may-carry occasional willow, as does northern Vancouver Island itself. A small form which is especially common on Balaclava Island presents difficulties which have so far prevented its determination.

A large part in the picture, as seen from the shores, is played by the salal, *Gaultheria shallon* Pursh. This shrub, which may form impenetrable jungles twelve feet or more deep, is apt to create a troublesome understory in flatter areas under light but continuous forest, as over Cape Caution, or to line dark shores, but does not persist in the open nor in the deepest shade of spruce or hemlock. It may be said in some degree to fill the niche left vacant by the willows at the forest edge.

The most interesting of all, the much sought "Yellow Cedar," *Chamaecyparis nootkatensis* (Lamb.) Spach. has been intentionally left to the end, as its peculiar status carries strong suggestions of historical change. If, in search of raft logs or shake bolts, one coasts the inner shores of the outer islands, in a small boat, the subtle difference in foliage color makes it possible to locate frequent large trees of this species, near the beach. But such trees are all ancient, and the surrounding saplings are not of *Chamaecyparis*, but probably of *Thuja*. On nearby exposed but sunny points *Chamaecyparis* in the scrub phase may be abundant. Along south-facing lake shores in the interiors large-butted but low and gnarled *Chamaecyparis* are found, often as "sweepers" leaning over the water, often dying and bestridden by some triumphant younger *Thuja* or *Tsuga*. Again nearby may be quantities of scrub, occupying, as at timber line, exposed and impoverished rocky niches, but little or no signs of potential replacement of forest growth of the species. If one is seeking, instead of heavy timber, trolling poles or small-boat knees, it is usually necessary to climb a thousand feet or so on a well-timbered southern aspect of some outer hill, as on southern Calvert. Here may be found beautiful stands of saplings, true yellow cedar forests in the making, yet extremely few giant trees. This continues to the summit, soon petering out into the characteristic timberline scrub of the outermost hills, which gives way to hemlock scrub on the higher summits of the inner islands, as on the peaks of Princess Royal above Graham Reach, and finally to *Abies amabilis* scrub at the inlet heads, as above Bella Coola.

Now it lies within the bounds of possibility that this arrangement of *Chamaecyparis* may merely represent a stage in the normal procession toward a climax, that an ancient lowland forest of the species, having sheltered other forms, is now being eliminated by them. None the less the probability that such a process has been aided either by great edaphic changes, or climatic amelioration, or both, seems very strong. *Chamaecyparis nootkatensis* is a peculiar species. Throughout its range it demands exposure, usually maritime exposure, but, somewhat contradictorily, exposure combined with warmth and sunshine. It is, in a way, a mistake to think of the giant timber trees as the most vigorous and successful expression of the species. Its greatest density and only dominance is as a scrub at timberline or on analogous beach locations, or over vast areas of muskeg plateau on northern Vancouver Island. It gives way very quickly before severe conditions as expressed by cold or excess snow. On all the inner parts of our area its appearance becomes merely occasional and without significance. If in very recent time its zone of mass occurrence has risen in altitude, it seems probable that it has done so partly on account of greater average warmth, partly on account of the accumulation of enough soil to support a competitive forest which has deprived it of light and warmth over the forested areas of the lower levels of the outer islands.

Space is not available here for discussion of the herbaceous flora. Suffice it to say that undoubtedly many forms drop out in an erratic manner not only through the Coast Range and the deep inner zone, but from the headlands to the nearest islands and from the inner islands to outer. Yet this reduction, be it observed, occurs *pari passu* with climatic *amelioration*. To whatever degree edaphic considerations may affect the forestation, it hardly seems likely to play so large a part in the case of small plants. With increasing experience one is more and more induced to fall back upon historical considerations, and regard the whole scene as an unusually spectacular and distinct example of a flora in movement. To choose a single very typical illustration, *Aquilegia formosa* Fischer, abundant through the Coast Range and down to the inlet heads, reaches the headlands only occasionally. The only island of any great degree of separation upon which we have found it is Calvert, yet it has reached and thrives in the crevices of the bare gull-rookery of Zero Rock in the mouth of Rivers Inlet and on tiny Ann Island in Queen Charlotte's Sound, as well as on some of the Goletas group. This is evidence enough that neither outer exposure nor maritime conditions form a barrier, but that in all probability relatively low rate of spread, a migrule not well adapted to transference over the areas in question, and hence too brief a Recent period for the completion of spread and establishment, are involved.

THE PASSAGE OF THE SALT WATER BARRIERS

Many years of familiarity with the spectacular glacial phenomena of the islands and inlets, combined with the overwhelming concensus of geological opinion on late Ice-age conditions, as summarized in Section I, have convinced us that the biological phenomena of the area are only to be interpreted in the light of a suspension of most terrestrial vertebrate life during the last glaciation.

Yet if this were proved to be untrue, a different set of circumstances would, biologically speaking, present a very similar historical framework. If the coast was not covered by an unbroken ice-sheet, at least the outer zone and many of the smaller shoreward islands or archipelagoes lay beneath the surface of the sea, and the problems of age and means of colonization remain unchanged for a large proportion of the land units.

For a time the problem of the spread of higher forms of life seemed insoluble. One asked oneself how many years, or how many centuries, it might be necessary to patrol the beaches of a given island before a log came floating by passengered by a pregnant female *Peromyscus*, and how much smaller might be the chances of the slow-moving amphibian *Ambystoma decorticatum* Cope, to which a dash of salt spray is probably death.

Yet, with increasing experience, it was conviction as to the nature of the historical scene which grew, and doubt as to the possibilities of post-glacial transfer which diminished and well-nigh disappeared. One saw the stormy spring tides lift millions of feet of timber from the rocks, and heard the crash and whip of ancient sweepers giving way at last and departing down the tide with half a ton of earth in their erected roots,—down a tide which might set from shore to shore of a tortuous channel several times before it found a point of escape. One found such roots and hollowed logs strewn along shores on which they never grew, still holding great masses of rubble, rock, and clay. One became conscious of long stretches of steep shore every yard of which showed some stage in the obliteration of a slide, from the slip of a few yards of humus and a few alders to a broad avalanche from high timberline, leaving the rock bare and carrying millions of feet of timber, along with every creature that lived in its hollows or among its roots. And it was only with final understanding of the peculiar type of avalanche which is characteristic of these shores that the most likely method for the transfer of small forms of terrestrial life came to be understood.

The common type of mountain avalanche through timber is of course started by and consists mainly of spring-softened snow, and except on extreme declivities occurs for the most part in the spring on a southwesterly arc of exposure. Sometimes, with exceptional speed and power, a narrow central trench of naked soil may be excavated, but in the vast majority of cases the surface is covered by lodged alder or willow, that yield and rise, while the lateral timber is broken well above ground by the snow or wind. The soil remains fixed to its bed-rock, But for the occasional trenching, on a narrow central line, stumps, roots, and burrowing animals will survive.

In the area under discussion, as has been pointed out, the thin, spongy, saturated, humic soil is hardly better fixed to its rock than is the spring snow at the heads of such typical alpine slides. Actually, as the crest of almost any bare cliff will show, there is a seepage, a thin film of living water, between rock and humus. Thus the soil with its great load of timber, moss, and herbage, is very apt to behave as the snow does, and slide clean, into the salt water, lake, or stream course below. This may happen with the aid of heavy high-level snow, or quite independently of it, as in the example shown in Plate V. Whatever the immediate occasion, whether the mere attainment of the limit of safety as to size of load, or a sudden increase in the amount of subterranean water, or both, this type of slide carries everything with it, and except for persistent deposits in safety angles, the operation of soil-building must begin again. Where the shores are steep enough to slide, the channels are deep and abrupt. Therefore jams are not formed on the beaches, but tangled "rafts" are flung directly into water deep enough to float them. Such rafts, with their interlocking root-systems, are much more coherent than the shattered, rootless fragments hurled into mountain lakes or upon lake ice by inland avalanches, only to float apart with the imminent thaw. They are said to last for months as units, shifting from point to point with the higher tides.

It is our great ill-fortune never to have seen or been able to investigate such rafts afloat or in their entirety, but we have many word-of-mouth accounts of them. The one perfectly fresh slide of this type we have seen is illustrated by Plate I. It occurred at Port Alexander on Nigei Island very late in the autumn of 1939 and was photographed by us in the following May. None of the timber except the few sticks shown remained on the beach, and only heavy seas could have torn apart the heavy, interlocked tangle, floating two-thirds under water, which must have resulted. Supposing an ebb tide carried this to the mouth of the shallow bay, the swift currents of Goletas channel might have moored it alongside almost any island of the Goletas or Gordon group in a few days or hours, or carried it across to the shores of Vancouver Island. How large a passenger list of small, crevice-inhabiting animals, especially such as could swim in salt water and scramble quickly to elevated points, might be carried by such a raft, of trees and stumps with their hollows, and roots with their loads of humus and duff, remains a matter of speculation. None the less, as a potential mode of transport, such a phenomenon, occurring with a relatively high frequency over a considerable fraction of Recent time, ranks very high.

In addition to many more vague or less reliable reports on this subject we have to thank Mr. Allan Lyon and Mr. William Cadwallader, of Hardy Bay and Fort Rupert, respectively, for information based on their unparalleled knowledge of the shores of Queen Charlotte's Straits, where, owing to the excellence of the timber of Seymour and Kingcome inlets, such rafts have special economic value. They tell us that "slide raft logging" has for many years been regular procedure in Seymour. They themselves broke up one raft, and know of many others. In the case of a famous raft in Simoom Sound (Kingcome Inlet), in the autumn of 1925, the loggers towed out a donkey engine and extracted twelve logging-raft sections. This raft had started from upper Kingcome and floated, by some freak of the tide, continually outward at a rate of six or seven miles a day. On Wakeman Sound in the same area a slide started at a mountain top and was three miles in width at its foot, along the salt waterfront. All of it went directly into salt water or near enough to be taken by the first high tides. Apropos of the transport of animals by such means, Mr. Cadwallader tells of drawing up alongside two crossed logs floating in the open sound between Wells Pass and Malcolm Island when a red squirrel jumped from them to his boat and ran up the rigging to the masthead, where it remained until he made shore.

The gradual seaward decline in altitude and steepness might be expected to give the movement of a population front by such a mechanism a certain direction. The abundance and size of the slides of course correlate both with altitude and steepness and with increased rainfall. They are the largest and most numerous on the inlets and headlands, next largest on the inner shores of the inner island zone, small and sparse on the outer shores of the inner row, very rare and extremely small on the inner shores of the outer rank, and reduced to zero, or the occasional clearance of a falling sweeper, on the outside coasts. Thus, to chose one latitude, the exchange, in a long-term sense, might be very rapid across middle Granville Channel, betweeen the mainland and Pitt Island, but with considerable margin in favor of material of mainland origin, owing to higher and more precipitous average slope descending more steeply into the water. In the next rank, between Pitt and Banks, the exchange might be expected to be much smaller, and in favor of material originating on Pitt, but exchange there would be, for some of the inner shores of Banks, though low, are quite steep. Farther south, the same relation obtains between the mainland and Princess Royal, but between Princess Royal and Aristazabal the greatly reduced exchange might be expected to move almost entirely toward the west, as the inner shores of Aristazabal hardly have a point high enough to slide. The single cluster of hills lies well back from the beach. On the outside a most interesting question arises. The shores are flat, the course of drift no longer channelized, yet the Moores, six miles offshore and minute in size, have been populated by *Peromyscus*. The immense amount of drift, including an occasional wrecked boat, which not only is thrown up on these islets, so small a target in so wide a sea, but finds its way into their minute inner lagoons, is surprising. Its general explanation, we believe, as in other similar cases, lies in the creation by the group of a sort of vortex between the escaping inshore tides, the onshore set of the margin of the great outside current, and the prevailing onshore winds. Even so, the transport of living animals over such a distance, on such seas, is surprising enough.

Such a general situation suggests a greater chance of the transfer of headland populations toward the islands than of the reverse,—a tendency which would be augmented by the greater aggregate area and probably greater total size of the headland populations. Such a law would involve the conclusion that mainland or inner-island mutation products would be more apt to reach outer land-units than the opposite.

It is also necessary to consider the possible extent of human agency in the transfer of mammals, although there are few island-groups in the world where such agency is less likely to have played a considerable part. A very large proportion of the islands are uninhabited, but this is more true for the present than for old Indian days. Except for a very small one on Denny, there is no permanent white community on any island. There are canneries on Princess Royal, Swindle, and Denny, which create a large small-boat traffic, with periodic calls by steamships, during the summer. These are much too recent to have been responsible for the rodent populations of large islands such as the first two, and we have in all cases taken care to avoid the proximity of canneries for collecting. Our material from Princess Royal and Swindle was shut off from them by mountain ranges. Denny we avoided. Campbell is one case in which a large Indian village of today lies close to an ancient Hudson Bay settlement, reaching back over a century, and one might fear human interference were it not for the fact that the Campbell mice are simply one unit of the extremely sharp ***rubriventer*** variant which exists on many other small islands, including some of the least frequented of any within our latitudes.

Over a quarter of a century ago attempts were made to found extremely small white settlements behind Safety Cove on Calvert and on the northern tip of Banks. These few families did not remain long enough to finish their cabins, though on Larson Harbor, on Banks, one new cabin is now occupied in summer. The Safety Cove community caused a few calls by steamers of the Union S.S. Co. Here also one new beach cabin is sporadically occupied today. For some years a mine has been operated above the head of Surf Inlet in the northern interior of Princess Royal. There have been two immediately abandoned attempts by individuals to settle on northern Aristazabal, which never reached the cabin-building stage. There are two sporadically occupied white cabins in the south end of Pitt. A quarter of a century ago a white man attempted to winter on

Table and half finished a small cabin, but was unable to hold his boat and departed. The few and flimsy shake shelters of trappers, especially on Princess Royal, have been burned almost as fast as built, as a result of trappers' feuds. Abandoned cabins are commoner south of Queen Charlotte's Sound, in the Goletas and Gordon groups. The area includes three tended lighthouses, all on small islets, none of them, except in slight degree Pine Island, treated in this paper.

Outside the canneries the extremely small white population, quite literally "floating," exists on boats and rafts, and rarely steps ashore. Even water today is supplied to fishermen by the fish-buyers, from the home ports, and wood is little used as fuel. Of late years, in the intense competition for salmon, fish-buyers at permanent summer anchorages have become more and more common, but exist on scows and rafts, with rarely more than a steel cable run ashore. There is no logging on the islands, except in rare cases of islands within inlets. All this in any case is far too recent, with the theoretical exception of Campbell Island, to have affected the population of *Peromyscus* as we found it.

Very different is the situation as to the native tribes. Although the remarkable life once enjoyed by these people has been destroyed by the usual sequence of causes, the present picture does not hold for the recent past. The coming of the fragile, expensive, unmanageable "gas boat," which demands good anchorage, has left the outer islets and the outer shores, the very cream of the country, almost as inaccessible to the Indian as to the white man. No longer bases for fur-sealing or inshore halibuting, no longer sought for the cod, bird's eggs, and abalones, only the rotting smoke-houses, at whose doors fleets of canoes were once drawn up, tell of the life which flooded these exquisite spots for a thousand forgotten summers.

Permanent native villages appear always to have sought the inner island shores or the inlets, apparently preferring protection from the winter wind to the lighter rainfall and snowfall and the better fishing of the outside. At present two exist on islands, Klemtu on Swindle and Bella Bella on Campbell. In the old days the populations of these and others further inland spread outward in summer to many individual summer camps or "illahees" or "summer villages," even as far as Goose Island. The same populations are now absorbed in summer by the white man's commerce, the women into the canneries, the men into the fishing fleets. And so, except for occasional brief visits by the children of their one-time owners, for a little summer fishing or winter trapping, the sites which were jealously divided and fought over among the primitive tribes are rapidly being forgotten, like the great trails and waterways of the northern interior. These occasional visitors, but for greatly reduced and rapidly decreasing beach trapping in winter, rarely go ashore and practically never live ashore. We have never, in the course of our necessarily minute reconnaissance of shore-lines, found an island too remote to show ancient and forgotten dead-fall traps for mink and otter, beautifully made but fallen in ruins. Sign as well as report of present trapping is relatively slight. The few rich and obvious lines which are not neglected are at least never run with the intensive thoroughness of the well exploited interior.

In many years of sporadic travel of these shores in small boats we have never seen or heard of a *Peromyscus* on a boat, yet *Peromyscus*, in camp or cabin, makes its presence known at once. This is the less surprising in that, except at the rare communities just mentioned, it is practically always necessary to anchor offshore. On the other hand it must be admitted that large canoes, reaching fifty or sixty feet in length, drawn up on beaches and full of the redolent paraphernalia of Indian life, might well have been attractive to beach-haunting, cabin-frequenting mice of this species. One might the more readily seize upon such a means of transfer as accounting for populations like those of the Moores and Goose were it not for the abundance of *Microtus* on the latter and of *Microtus* and *Clethrionomys* on other islands, genera which never enter houses or cabins, and which have little interest in beaches or bait.

No one knows the antiquity of the Indians in the region, and it certainly cannot be said, especially in the light of the smallness of some of the populations of *Peromyscus* which have taken on racial character, that they might not have done so since the Indian civilization came into being. The possible importance of such an adjunct to more natural means of dispersal will remain forever in the field of speculation. It has not, at any rate, served to obliterate abundant endemism.

SECTION III

THE FAUNAL ENVIRONMENT

1. *Numbers of Specimens*

During the course of this field work on the islands and coastal mainland of central and northern British Columbia we obtained 1391 specimens of small mammals. By far the greater part of these, 1216 specimens in all, were taken upon the islands and only 175 specimens had their origin upon the mainland. From its earliest inception our activity was directed primarily toward obtaining series of mice of the genus *Peromyscus*. All other small mammals trapped were merely incidental to this primary object and accordingly the series of many of them are small.

Specimens secured and prepared by us consist of 993 *Peromyscus*, 240 *Sorex obscurus*, 43 *Sorex cinereus*, 38 *Sciurus hudsonicus*, 34 *Microtus*, 13 *Clethrionomys gapperi*, 7 *Synaptomys borealis*, 9 *Mustela vison*, 2 *Canis lupus*, 2 *Glaucomys*, 2 *Zapus princeps*, 2 *Myotis lucifugus*, 2 *Lasionycteris noctivagans*, 1 *Mustela cicognanii*, 1 *Sorex palustris*, 1 *Neotoma*, and 1 *Erethizon*. Of these genera and species all save *Neotoma*, *Zapus*, *Erethizon* and *Sorex palustris* were found to occur on the islands as well as upon the adjoining mainland.

In addition to our own material we have had available for this study 202 specimens of *Peromyscus*, *Clethrionomys* and *Microtus* from the mainland coast adjacent to and south of our area and from Vancouver Island, and three smaller islands in the general region. These were loaned to us by Dr. R. M. Anderson, of the National Museum of Canada, to whom we express our thanks. Many other specimens from adjacent regions in the collections of the Museum of Vertebrate Zoology, the British Columbia Provincial Museum, the Museum of Zoology of the University of British Columbia and in the Kenneth Racey collection have been referred to. Topotypical material of *Peromyscus maniculatus macrorhinus* was loaned to us from the United States National Museum through the courtesy of Dr. H. H. T. Jackson.

Localities

In the course of the three years spent, in part, in obtaining the source material for the present study of insularity we set traps for small mammals upon 38 islands between Dixon Entrance and Queen Charlotte Strait (latitudes 54° to 50° 45′). Upon only two of these—the largest

Laidlaw Island and Ann Island—were we unable to obtain small mammals of any sort.

The islands upon which specimens were obtained, arranged in approximately north-south series, are as follows: Porcher, Pitt, McCauley, Banks, Campania, North Estevan, West Estevan, Princess Royal, Aristazabal, Moore, Swindle, Price, Yeo, Chatfield, Reginald, Smythe, Townsend, Dufferin, Horsfall, Campbell, Hunter, Hunter "B," Hunter "C" = (Ruth), Spider, Goose, Hecate, Calvert, Table, Hope, Nigei, Balaclava, Hurst, Heard, Duncan, Bell and Doyle. Specimens from Pine Island, King Island, Calvert Island and Stuart Island were also borrowed from collections in other museums.

So as to correlate our insular mammals with the mainland population at corresponding latitudes, we established collecting stations at several points on the mainland coast. Later during our consideration of these mainland sites it became apparent that, as we have explained later, some of them were but recently joined to the continent and that the small mammal populations on them might well exhibit as much result of insular isolation as those of some of the existing islands. Among these can be included the Don Peninsula and the north shore at the entrance to Schooner Passage. Lowe Inlet and Koeye River are probably truly continental. In our study of the mainland populations we have had access to the extensive collections from the region in the National Museum of Canada. From this source we have had specimens taken at Loughborough Inlet, Kingcome Inlet, Rivers Inlet (south side and north side), Bella Coola, Hagensborg and Kimsquit. Most of these localities are situated near the heads of inlets and on truly continental areas. They can be taken as representative of the mainland population at their respective latitudes.

2. *The Mammalian Community*

As has already been indicated, there is no evidence that the present mammalian fauna of the islands adjoining the coast of British Columbia predates the last ice inundation. The same condition can be said to obtain to Vancouver Island in so far as the bulk of the fauna is concerned. However, on this island two alpine species suggest that a longer period of isolation has contributed to the present characters of these forms. The Vancouver Island marmot, *Marmota vancouverensis*, while a member of the *caligata* group, is specifically distinct from continental members of the species *caligata*. In this instance it seems to us that isolation for a period longer than the immediate post-Pleistocene has been necessary to foster the development of the distinguishing characters. The presence of this marmot on the high peaks of Vancouver Island suggests to us the

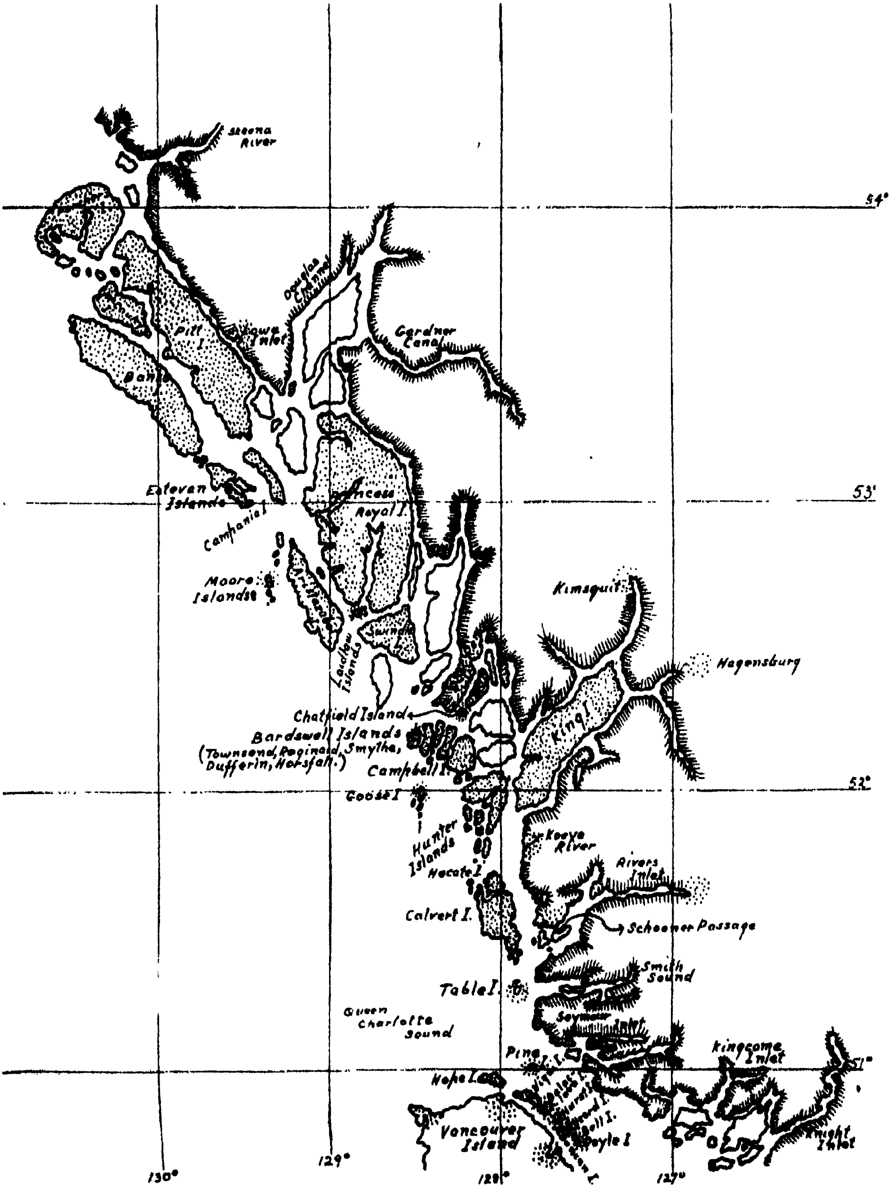

FIG. 3. Dotted areas indicate islands represented or mainland stations.

presence, in these areas, of habitable land, during the last ice age at least, and supporting a limited residual fauna. The presence on Vancouver Island of a well differentiated race (*saxatilis* Cowan) of the implastic ptarmigan species *Lagopus leucurus* serves further to bolster this interpretation of the situation.

While there may be room for scepticism regarding the survival on Vancouver Island of a pre-ice age residual fauna, there can be no doubt concerning the Queen Charlotte Islands. Here there is no evidence of an overriding ice-cap and the distinctive fauna, including such unique mammal species as *Rangifer dawsoni*, *Martes nesophila* and *Mustela haidorum*, the races *Ursus americanus carlottae, Peromyscus sitkensis prevostensis* and *Sorex obscurus prevostensis* together with well characterized races of Steller Jay, Pine Grosbeak, Hairy Woodpecker and Saw-whet Owl, testifies to a long period of isolation. That part, at least, of this fauna is of preglacial or interglacial origin seems to be an inescapable conclusion.

The fauna.of the islands more closely adjoining the mainland coast, as it is known to us, consists of a selection of species found also on the adjoining continental shore.

This mainland fauna consists of the following terrestrial mammals: **Sorex cinerus*, *Sorex obscurus*, *Sorex palustris*, *Martes caurina*, **Mustela cicognanii*, **Mustela vison*, *Gulo luscus*, **Ursus americanus*, *Ursus horribilis*, **Lutra canadensis*, **Canis lupus*, **Sciurus hudsonicus*, **Glaucomys sabrinus*, **Castor canadensis*, **Peromyscus maniculatus*, *Neotoma cinerea*, **Synaptomys borealis*, **Clethrionomys gapperi*, **Microtus longicaudus*, *Zapus princeps*, *Erethizon epixanthum*, *Ochotona princeps*, *Lepus americanus*, **Odocoileus hemionus* and **Oreamnos americana*. Those species marked with an asterisk are known to occur on one or more of the islands studied, other than Vancouver Island. The mammal fauna of these islands, as it is known to us, is outlined on Table 1. It must be assumed that certain of the smaller species are present on islands upon which we were unable to capture them. The brevity of our activity on many of the islands precluded the establishment of negative conclusions with regard to rarer species. However, certain important absences have been reasonably well substantiated. Thus about 600 trap nights on Spider Island failed to take *Peromyscus* or other small mammals except shrews and squirrels. An even greater number of trap nights on Aristazabal and Table islands failed to capture anything but *Peromyscus*, and approximately 250 trap nights on the largest Laidlaw Island and fifty trap nights on Ann Island failed to take small mammals of any sort. The latter were the only islands of the thirty-eight that were found to be completely without a small mammal fauna.

It has been assumed that otter reach all the islands worked and that

TABLE I

	Porcher	Pitt	McCauley	Banks	Campania	N. Estevan	W. Estevan	Princess Royal	Aristazabal	Moore	Swindle	Yeo	Chatfield	Reginald	Smythe	Townsend	Dufferin	Horsfall
Peromyscus	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Sorex obscurus	x	x	x	x	x		x	x			x		x	x	x	x		
Sorex cinereus		x	x					x							x	x		
Microtus longicaudus								x			x							
Clethrionomys gapperi								x										x
Synaptomys wrangeli																		x
Sciurus hudsonicus	x	x	x		x						x	x	x	x	x	x	x	x
Glaucomys sabrinus																		
Odocoileus	x	x	x	x	x			x	x		x	x	x	x	x	x	x	x
Ursus		x?						x	x(1)			x						
Canis lupus	x	x	x	x	x			x	x		x							x
Mustela vison	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
" cicognani								x			x							
Lutra canadensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Castor canadensis	x	x	x	x	x			x	x		x							
Oreamnos		x																
Microtus tetramerus																		

TABLE I—*Continued*

	Spider	Campbell	Hunter	Hunter B.	Ruth	Goose	Hecate	Calvert	Table	Hope	Nigei	Balaclava	Hurst	Heard	Duncan	Bell	Doyle
Peromyscus		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Sorex obscurus	x	x	x	x	x	x		x		x			x				
Sorex cinereus	x	x	x		x												
Microtus longicaudus						x											
Clethrionomys gapperi																	
Synaptomys wrangeli		x															
Sciurus hudsonicus	x	x	x	x	x			x									
Glaucomys sabrinus		x															
Odocoileus	x	x	x	x	x		x	x		x	x	x	x	x	x	x	x
Ursus																	
Canis lupus	x	x	x	x	x		x	x									
Mustela vison	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
" cicognani																	
Lutra canadensis	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Castor canadensis		x	x	x				x									
Oreamnos																	
Microtus tetramerus										x			x				

mink reach all but the most seaward. In many instances signs of these animals were obvious and the animals themselves or their remains were seen on several islands. Apart from these two species *Peromyscus* enjoyed the widest distribution. It was found on thirty-four of the thirty-six populated islands trapped. Second in abundance and distribution among the smaller species was *Sorex obscurus*, taken on twenty-three islands. Shrews were not taken on Aristazabal, Moore and Table islands despite fairly intensive trapping, and their absence from these islands seems probable. *Sciurus hudsonicus* was taken on twelve islands, and signs of its presence observed on six others. Less widespread were *Sorex cinereus*, taken on nine islands, *Microtus longicaudus* and *Microtus townsendii* on three, *Clethrionomys gapperi*, *Synaptomys borealis* and *Mustela cicognanii* each on two islands, and *Glaucomys sabrinus* on but one. The presence of *M. townsendii* on certain islands of the Gordon group indicates that these islands derived their fauna from Vancouver Island rather than from the mainland, for this species occurs elsewhere in the area only on Vancouver Island.

Among the larger mammals deer were found to be on all save Moore, North and West Estevan, Goose and Table islands. Indians report that they were formerly present on Goose Island but were exterminated by feral domestic dogs. Wolves are almost as adept swimmers as are the deer and probably visit almost all the islands upon which deer occur. Only those upon which wolves or their tracks were seen are indicated on the chart. Bears were encountered only on Princess Royal and Pitt islands. They are known to be present on Gribble Island, which we did not trap. A group of Indians whose families had hunted Aristazabal for generations expressed immense surprise at finding and killing a black bear on the southeastern shore some four or five years ago. Goats are said to occur only on Pitt Island.

Present and past methods of transport available for the shifting of populations of small mammals from mainland to island or from island to island are dealt with elsewhere. Perhaps the highest testimony to the efficiency of these methods is the presence of certain amphibians on the islands. While it is possible to imagine an island acquiring a small mammal population through the landing of a single pregnant female, this postulate is not tenable for the amphibia. Their reproductive behavior demands that a representative of each sex be present together at or very shortly prior to egg laying. Furthermore the amphibia are unable to withstand even brief submersion in salt water and accordingly cannot have arrived by their own activity. *Ambystoma decorticatum* was taken on Spider Island, Hunter Island, and Princess Royal Island, and a salamander believed to have been this species was trapped on Reginald Island and Townsend Island. *Bufo boreas* was of widespread occurrence.

Microtus

Two species of *Microtus* are present in the area studied. Both have established colonies upon some of the islands but nowhere do they occur together.

The only microtine known to inhabit Vancouver Island is *Microtus townsendii tetramerus*, a species that occurs throughout the island at elevations varying from sea level to at least 4500 feet. The same mouse was taken by us on Hurst, Hope and Nigei islands, adjacent to northern Vancouver Island, thus establishing the probability that these islands and the others associated with them derived at least part of their fauna from Vancouver Island rather than from the mainland coast.

On Vancouver Island *Microtus t. tetramerus* exhibits geographic variation in size of hind foot, length of tail, and in most of nine cranial measurements taken. The population on the southeast coast is smallest in these features, that on the west coast at Alberni and Tofino has these parts of greater size. The insular populations referred to are even larger, particularly in greatest length of cranium, zygomatic breadth, interorbital breadth, and greatest width of rostrum. In comparison of this insular group of specimens with a small series of topotypes from the vicinity of Victoria many of the size differences are demonstrable as statistically significant.

However, when the island specimens are compared with the series of eight adults from the west coast of Vancouver Island (Alberni, Sproat Lake, and Tofino) the differences become relatively insignificant. In the light of existing information it is apparent that there is a more or less continuous cline with respect to dimensions along the length of Vancouver Island. The smallest individuals with small feet and skulls are confined to the southeastern Transition Zone strip while to the north and west there is progressive size increase culminating in our insular populations on Hope, Nigei, and Hurst islands. This condition is almost exactly paralleled by the variation in *Peromyscus* from a small, short-tailed mouse in the southeast to a large long-tailed mouse to the north and at higher elevations. In *Peromyscus*, however, there are color differences between the two populations and these taken with the dimensional features permit recognition of two distinct subspecies, *P. m. angustus* Hall and *P. m. interdictus* Anderson respectively. In the absence of any external qualitative differences of a discontinuous nature and in the circumstances of size distribution already mentioned, it seems that the naming of an additional race of *Microtus townsendii* would contribute nothing to the understanding of the situation.

The only *Microtus* taken on the mainland coast is a race of the species *Microtus longicaudus*. The combined specimens resulting from our expeditions and those of the National Museum of Canada number eighteen adults, several of which have broken skulls. These were taken at Powell River, Stillwater, Stuart Island, Loughborough Inlet, Kingcome Inlet, Rivers Inlet, Schooner Passage, and Neckis River. Except for a slightly smaller foot, probably not significant, the mean external dimensions of this series do not differ from the Olympic Mountains series of five adults cited by Bailey (N. Amer. Fauna, no 17, 1900:51). Again like these Olympic peninsula specimens our series of adults with two exceptions have the under side of the tail almost the same color as the upper side. In the absence of any evidence to the contrary, then, it seems that the coastal series can without violence be referred to the race *M. l. macrurus* Merriam.

Specimens of this mouse were obtained on Goose, Swindle and Princess Royal islands. No more than two or three specimens were obtained on each and these do not depart significantly from the mainland series with the exception of those from Goose Island. Two adults from this island, while of much the same external dimensions as those of the mainland, have the skulls broader, heavier, and with longer nasals and tooth rows. However, only in zygomatic width is the observed difference significant, while body length ($P = .03$) and basilar length of Hensel ($P = .02$) are possibly significant. If additional specimens support the indications provided by these two adults, the population of Goose Island can be taken as racially distinct from *macrurus*, and will then provide additional evidence of the effective isolation of this island group.

Clethrionomys gapperi

Our series of red-backed mice from the outer coast of the mainland and from the islands adjoining consists of 14 specimens: 5 from Beaver Seining Ground, 4 from Lowe Inlet, 1 from Dufferin Island, and 3 from Kent Inlet on Princess Royal Island. In addition to these we have had available for comparison the following specimens from the mainland coast: Horseshoe Lake (virtual topotypes of *caurinus*) 4, Loughborough Inlet 1, Kingcome Inlet 1, head of Rivers Inlet 9, Kimsquit 2, Hagensborg 7. There is considerable variation in this series with regard to extent of the dorsal stripe. In the Schooner Passage specimens the dorsal color instead of being confined to a more or less restricted band spreads onto the sides. In two of them the red extends completely over the sides and as a wash across the abdomen. In the majority of specimens, however, the stripe is well defined, and restricted to the dorsal surface. The entire series, with minor variations, agrees with the topotypical specimens of *caurinus* in dimensions and in color characters. The distinctive pinkish hue of the dorsal stripe together with the yellowish rather than gray sides readily distinguish the coastal series from *saturatus* inhabiting the Cascades south of the Fraser River and the entire southern and eastern parts of British Columbia. The extent of the dorsal band, yellow sides and the reduced number of long black-tipped hairs on sides and dorsum distinguish *caurinus* from *occidentalis*.

We have not personally made comparison with *Clethrionomys phaeus* (Swarth) from the coast of southeastern Alaska but the small size and short tails of our specimens seem to remove them from this species. There is a single exception to this, as the only adult from Lowe Inlet has its external dimensions above the mean for *phaeus* as cited by Swarth (1911, p. 127). This may indicate intergradation between *phaeus* and *caurinus* in the region adjacent to the mouth of the Skeena River. However, further specimens will be necessary before the significance of this one can be determined.

Synaptomys borealis

Voles of this genus were taken at Neckis River on the mainland (1 specimen), at Ormidale Harbour on Campbell Island (2), and on Yeo Island (4). These are all apparently referable to *Synaptomys borealis wrangeli* of which comparable material has been available from Metlakatla, head of Ootsa Lake, and Mt. Whistler, near Alta Lake.

Glaucomys sabrinus

Just two flying squirrels were taken during our field work, one at Koeye River, another on Campbell Island. Unfortunately the skull of the latter became lost in the field. However, both specimens agree closely in color. In the aggregate of characters exhibited by these two specimens they seem to be intermediate between *G. s. reductus* Cowan and *G. s. zaphaeus* (Osgood). In color they are virtually indistinguishable from topotypes *reductus* and from comparable specimens from Chezacut. The single skull is smaller than the minimum of a series of specimens of *reductus* in some measured features and in this respect resembles *zaphaeus*. However, the material is too meager to permit the formation of any positive conclusions.

Sciurus hudsonicus

Our series of squirrels consists of 39 specimens distributed as follows: Porcher Island 1, Lowe Inlet 3, Pitt Island 1, McCauley Island 1, Campania Island 3, Swindle Island 4, Neckis River 1, Bella Coola 1, Townsend Island 12, Campbell Island 1, Spider Island 1, and Calvert Island 10. For comparison we have had a series of 20 specimens from various localities on Vancouver Island and large series from other mainland localities.

The entire series from the islands and mainland coast north of Queen Charlotte Sound exhibits great uniformity. In comparison with the Vancouver Island population all winter skins have the red of the dorsum slightly brighter and more nearly concentrated into a mid-dorsal band. However, in amount of black on tail, gray underside of tail, general body color, and in measurements, the populations show virtual identity. The external dimensions of a series of 18 adult males from Spider, Townsend, Swindle, Calvert, McCauley and Pitt islands and Lowe Inlet average as follows: total length 297 mm. (285-316), tail 110 (96-125), hind foot 47 (41-33). A series of 8 males from Vancouver Island (in Museum of Vertebrate Zoology) measure as follows: 294 (280-310); 112 (92-124); 48 (45-50), while *S. h. picatus* of southeastern Alaska is said by Swarth (1911:93) to have the following dimensions (based on 8 males): 312.4 (285-313); 125 (123-128); 50.75 (49-53), and is thus larger, with longer tail and much larger hind foot.

It would thus appear that the population of Vancouver Island is for the purposes of taxonomy very slightly differentiated from that of the mainland coast and northern islands as represented by our collections. Two names are available for this race of red squirrel. The name *vancouverensis* Allen, 1870, type locality Duncan, V.I., B.C., has been in use for over fifty years. The name *Sciurus lanuginosus* Bachman, 1838, has been of uncertain application. Osgood, 1907, drew attention to the name and to the correct type locality- Fort McLoughlin, B.C., as stated by Townsend (1839), rather than near Sitka, Alaska, as given in the original description. He erred in placing this fort on Hunter Island instead of adjacent Campbell Island. The fort stood very close to the site of the present village of Bella Bella. The locality nearest the type locality from which specimens were available to Osgood was Rivers Inlet. These specimens were *douglasi*, and thus Osgood suggested that *lanuginosus* and *S. d. cascadensis* might be synonymous. We now know that Rivers Inlet constitutes the dividing line between the ranges of *S. douglasi* from the south and *S. hudsonicus* from the north, and that it is to squirrels of the latter species that *lanuginosus* applies.

The type specimen of *lanuginosus* is a partial albino (examined by Cowan, 1936, in Philadelphia Academy of Sciences) and hence the correct application of the name rested upon the securing of topotypes.

The manuscript journals of S. F. Tolmie, the collector of the type specimen, are in the Archives of the Province of British Columbia where we have consulted them. Tolmie makes frequent mention of birds and mammals seen or shot, and though he travelled widely he makes no mention of taking squirrel specimens other than near the fort. There is no reason then to doubt Townsend's statement of Tolmie's verbal location of the type locality as already indicated. Specimens from Campbell Island and Hunter Island agree with those elsewhere in the region, as stated above.

On these grounds the rules of priority compel the use of the older name *lanuginosus* for the race of squirrels inhabiting Vancouver Island, the islands collected upon by us, and on the mainland coast north at least to Lowe Inlet. This race is easily distinguished from *picatus*, but in comparison with Vancouver Island squirrels the differences are seen to be slight.

Sorex

Of the two species of shrews obtained on the islands of our study, *Sorex cinereus* is represented by 43 specimens from the following mainland localities: Lowe Inlet 5, Neckis River 4, Koeye River 1, and from these islands: Pitt 4, Princess Royal 1, Campbell 7, Yeo 9, Townsend 3, Smythe 1, Hunter 1, Ruth 1, Spider 5, McCauley 1. This group of populations is remarkably uniform in general characters. We can detect no differences between populations attributable to geographic position. We are following Jackson in applying the racial name *streatori* to the mainland population and refer the insular specimens to the same race.

The geographic variation in *Sorex obscurus* in the study area has already been reported upon (Cowan, 1941). The species is represented by 240 specimens as follows: Lowe Inlet 13, Tom Bay 1, Neckis River 13, Koeye River 13, Schooner Passage 2, Porcher 4, Pitt 3, Banks 12, McCauley 2, Campania 2, West Estevan 7, Princess Royal 2, Swindle 2, Yeo 12, Chatfield 2, Campbell 7, Dufferin 2, Horsfall 8, Townsend 31, Smythe 28, Reginald 8, Hunter 3, Hunter "B" 3, Ruth 2, Goose 4, Spider 25, Hecate 1, Calvert 21, Hope 2.

Only comparatively few of the islands are represented by series of sufficient size to permit of study of the finer details of the results of insularity. However, the mainland population was found to be fairly homogeneous so far as observable characters are concerned. The Koeye River group suggest that they may represent a population with an appreciably darker winter pelage than those of the more northerly collecting stations, but the paucity of specimens in this pelage from the latter preclude the formation of definite conclusions.

Two insular populations were found to have developed into strongly characterized races. *Sorex obscurus insularis* Cowan, inhabiting Townsend, Reginald and Smythe islands, differs from *longicauda*, the mainland race, in more saturate color, dark brown rather than dark gray or black winter pelage, total length, tail length, and hind foot significantly less, and skull significantly smaller in condylobasal length and tooth row. In connection with these color differences it is pertinent to note that upon these same islands occurs the darkest, most saturate race of *Peromyscus* encountered by us. Shrews of approximately the same color characters occur on the Hunter Islands (including Ruth Island) and on Spider Island, but on this last the external dimensions—particularly body length—are greater. It now seems to us that the name *insularis* can be extended to apply to the slightly differentiated population of *Sorex obscurus* on Spider Island as well as those on Hunter, Hunter "B," and Ruth islands. Certainly these insular populations are closer to *insularis* than to mainland *longicauda*.

Sorex obscurus calvertensis Cowan, the shrew inhabiting Calvert Island and geographically remote Banks Island is paler than *longicauda* in both seasonal pelages and is smaller in the three external dimensions as well as condylobasal length, cranial breadth, maxillary breadth and length of upper tooth row.

Upon the other islands the small series do not differ significantly from the mainland population and are consequently referred to *longicauda*. It should be noted, however, that, as was the case in *Peromyscus* (see table 2), wherever an insular population differs in external dimensions from the mainland population it does so in actually and relatively shorter tail. Usually, also, there is shorter hind foot, shorter body, and smaller skull.

TABLE 2

COMPARISON OF INSULAR AND MAINLAND POPULATIONS OF *Sorex obscurus*

	Total Length	Tail	Hind Foot	Condylobasal Length	Palatal Length	Cranial Breadth	Interorbital	Maxillary Breadth	Tooth Row
Banks	—	—	—	—	—	—	0	—	—
Campbell	0	0	0	0	0	0	0	0	0
Horsfall	0	—	—	0	0	0	0	0	0
Yeo	0	0	0	0	0	0	0	0	0
Spider Hunter }	0	—	0	0	0	0	—	0	0
Calvert	—	—	—	—	—	—	0	—	—
Bardswells	—	—	—	—	0	0	0	0	—
West Estevan	—	—	—	—	0	—	0	—	—
Pitt	0	0	0	0	0	0	0	0	0

— = less than mainland. 0 = same as mainland. + = greater than mainland.

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SECTION IV

PEROMYSCUS

1. *The Favorable Associations*

All the associations, except timberline of the higher mountains, have been sufficiently trapped to yield a fair estimate of the relative distribution of *Peromyscus*. High grassland, above timberline, though extensively reconnoitered for other purposes, has only been trapped, quite fruitlessly, at one point, on Princess Royal Island. In the deeper inlets and beyond, the highest zones of nearly bare rock include a considerable fraction of the total horizontal equivalent, or map-area. Furthermore, as one moves eastward large areas of hard dry alpine meadow surmount comparatively dry forested slopes, all more or less suitable to *Peromyscus*. Here, therefore, population may be considered as effectively infinite. Such zones, however, have little interest for us except for defining the general range of the race *macrorhinus* and the neighboring variants. In the zone of the headlands and islands, where lie our peculiar genetic and historical problems, peaks and high ridges of bare rock constitute a very small fraction of the land surface, and the soil-covered high timberline is as a rule boggy. Dry alpine meadows of the usual interior type rarely occur. Therefore, since, as will be shown, *Peromyscus* avoids muskeg and bog, these associations may be ruled out as harboring any considerable fraction of the population of the headlands and islands.

During the first season's collecting the usual procedure was followed,—i.e., reconnaissance trapping of all associations but the highest, which, for practical reasons, has to be left for special efforts. Too gradually the realization awoke that, while all trapping, as compared to the interior, was poor, everything but the rock beaches was so bad that even meager success was rare and incidental. Our slow appreciation of this was due to the fact that intensive *Peromyscus* work was begun on Calvert, which is exceptional, as an outside island, in the possession of a few valleys with fine stands of firm, dry, level, spruce timber, on deep alluvial soil, and even a few ancient clearings with dry forest-edge conditions. In such places, on one or two occasions, as much as seven or eight per cent of the traps caught, though rarely, in virgin forest, more than three or four per cent did so. This, however, was far from characteristic. In general, on wetter or steeper forested slopes practically no catches were made over 25 yards from the beach. Over all the other islands traps set well inland in heavy timber failed to make over one per cent, and often failed completely. Even on tiny islands like Doyle and Bell lines run over timbered saddles from cove to cove caught nothing except close to the beaches.

Both in attacking the *Peromyscus* problem and from perpetual curiosity over the presence or absence of *Microtus*, large numbers of traps (between 1500 and 2000 trap-nights) were set over typical open muskeg, or on rock outcrops or islands of scrub in such muskeg, on Table, Calvert, Aristazabal, Campania, and Banks, without producing a single *Peromyscus*. On Aristazabal, behind Borrowman Harbor, a single individual was taken in a row of spruce in a stream-side gully winding through a wilderness of flat muskeg over a mile from the sea. On the other islands just mentioned no *Peromyscus* were taken in the interior, or even on the inner margin of the timber ring. From Hague Point anchorage on southwestern Princess Royal a line run up creeks through alternating hemlock forest, small lake borders, and grass-bogs, and finally over characteristic timberline grassland, with *Thuja* and *Chamaecyparis* scrub, false heathers, and other pure alpines, took nothing but *Microtus* above the beach. Lines run back and forth through the timber margin and the interior muskeg of Table took nothing inside the uppermost rock of the shores.

The shore lines were set from a skiff, usually only one or two traps at each landing if the tide, which may exceed twenty feet, were high, sometimes many more if it were low, though under the best conditions it is rarely easy to follow the rock far on foot. In the case of coarse broken rock catches were frequently made in the inter-tidal zone, often in seaweed-hung openings coated with barnacles. In the commoner case of smoothly-glaciated slopes the majority would be taken under overhanging roots at the forest edge, or in the piles of drift left by ancient spring tides. Perhaps the most favorable sign is absence of seepage, the next an abundance of dry rock crevicing or fracture above tide level, the third, which usually correlates with the first, the absence of alder or salal, or rank shrubbery or herbage, at the meeting point of rock and timber. Other factors being equal, exposed outside shore is usually better than inside, and is, in general, the most reliable association.

Three times only, in the course of the work, living *Peromyscus* were seen by daylight from the skiff, in all cases "blue" juveniles, searching the rock for some six feet above the water's edge, darting with mazy swiftness from one crevice to another. These were our only indications of diurnal activity. Traps left over a day never caught before evening. The richness of the shore foraging must be great, since all northern *Peromyscus*, as years of British Columbia collecting have shown, are much inclined to animal diet. The juveniles just mentioned were undoubtedly preying on hordes of small amphipods. Yet the population, presumably owing to the limitations of dry cover, is seldom large, and may probably be regarded as approaching its margin. The catch along promising beaches ran from from 0 to 15 per cent, averaging 6 to 8 per cent.

2. *Numbers*

In a complex of limited populations, with the nature of mutational phenomena in mind, some investigations of total numbers, as opposed to the mere effort to obtain enough skins for taxonomic comparison, is much to be desired. We can at least say that when we speak of small populations we mean really small, within the limits of laboratory capacity, though occurring under natural conditions. In the smallest populations at least some indication of numerical limits may be attempted.

During the last five years new and elaborate coast surveys have been published, and the problem of navigating the waters in question is much easier than it was at the beginning of our work. Detailed charts for the north of Milbanke Sound have made precise measurements possible. Similar sources for the southern portion are imminent, but not yet available. Undoubtedly, we would have been well advised to devote more attention to topographical reconnaissance, especially in the cases of the smallest islands.

Rarely does over half the circumference of a small island produce *Peromyscus* in any numbers. Fortunately for the collector, as has been explained, the more or less bare beaches are the best. This may be the result of outside exposure, dwarfing the brush, sweeping back the more tender types of cover, admitting the sun, or of some special conformation involving good drainage or preventing the deposition of alluvium. Table Island is a good example, with its well populated outer slopes of rock reaching back among the tree-roots, its inner and northern exposures precipitous, slimy, overhung, with no trace whatever of mice. Quite regularly, the larger and the more sheltered the island, the smaller the proportion of its shores which make good *Peromyscus* habitat. The poverty of both principal types of interiors have already been remarked upon.

It has been our experience that a good average line may, on the second night, produce half or a third of the first night's catch,—thereafter only a negligible and rapidly disappearing fraction. We are aware of many exceptions elsewhere,—areas where the supply seems almost bottomless,—but not on the northwest coast. It must be understood, however, that if we venture a tentative suggestion of a maximum possible population size, it is a lavish multiplication of our tangible evidence, based upon the assumption that we have not caught half the mice on our lines, nor found half the lines which might profitably have been trapped.

A. Islands of the lowest order of magnitude.

a. Islands inhabited by *Peromyscus.*

Of the smallest group,—Doyle, Bell, Heard, Table, and Reginald,—none exceeds a quarter of a square mile in area, a greatest diameter of a thousand yards, a circumference of 2000 to 3000 yards. Reginald, the smallest of all, is nearly round, and has a diameter of 350 yards. Its high rocky shores are favorable for about half the diameter, the interior not precipitous, but high enough to be well drained and forested. The shores and the interior were trapped for two nights and yielded 12 *Peromyscus,* with only one from the timbered interior. It is hardly thinkable that the total population could have reached a hundred at the time,—the trapper does not estimate that it could have exceeded fifty. The islet is separated from a point of Smythe Island by a short narrows some 75 yards wide and two fathoms deep at low tide.

Bell and Doyle, of the Gordon group, if slightly larger, have far less favorable shore-lines, and Doyle is a precipitous cone. Two nights trapping on each produced 20 and 15 *Peromyscus* respectively, and we cannot believe that they materially exceed Reginald in total population. The adjoining Heard is again somewhat larger. It was trapped only once and by no means covered. The most promising bit of shore produced 10 *Peromyscus* in 110 closely set traps. It is extraordinarily dry, especially on the inner shores, parts of which are carpeted with *Selaginella* and other unusually xeric plants. As the inner shore is also deeply embayed, and the interior relatively favorable, its population might run to several hundred. These three islands are separated from one another and from Hurst, as explained elsewhere, by very narrow gaps, but from Balaclava and the Goletas group by the broad and deep Christie Pass, a steamer passage. The similar-sized Duncan is less favorable than Heard, but has again been trapped only once, and not covered. It is separated from the rest of the group by a cable-length.

Most interesting of the small islands for its great degree of isolation and exposure and its brilliantly distinct endemic race, is Table. It is about a thousand yards in north-south length and between five and six hundred in width. Lines of 125 traps set four days and nights, if not covering the island at least sampling most of its associations, netted 19 *Peromyscus,* all on the rocky outer shore. Here the appalling attacks of slugs and large, bait-loving beetles, emitting evil odors of formaldehyde, reached a climax unequalled elsewhere, and may have in some degree modified our results. On one morning 81 huge slugs were removed from the boards of a line of 50 traps, while the beetles everywhere removed all traces of bait in a few hours. Even more irritating is the slug's habit, given sufficient time, of removing all the fur from trapped mice, leaving them white and naked, and the beetles of eating the skin and flesh from the heads, starting with the nose. None the less, betwixt and between, the favorable areas were fairly well covered, and no mice whatever were found in the salal, in the interior muskegs, or in the spruce or red cedar timber, so that the number taken must represent a very appreciable fraction of the population.

b. Islands not found to be inhabited.

Ann Island, a mere pendant of Table, though well forested and some three hundred yards in diameter, separated by a shallow gut some thirty yards wide at zero tide, and the larger of the tiny Laidlaw group, well isolated in the mouth of Laredo Channel, are as small as Reginald. Both appear to be favorable terrain, Laidlaw exceptionally so.

The apparent absence of *Peromyscus* from Spider Island, the outermost of the southern Hunters, in the light of the presence of squirrels and shrews, the presence of *Peromyscus* on three surrounding islands, and the size and suitability of Spider, is more unexpected. The island is flat, not smoothly so as in the case of Table, but with abrupt ridges and knolls, crested with pine, and numerous small muskegs and ponds, which drain, for the most part, to the eastern shore, which is therefore marshy and unfavorable. Isolation is by deep but quiet water, the minimum distance about 200 yards but with a minute intervening islet.

B. Islands of the Second Order of Magnitude.

Passing to the next larger group, Hurst, Balaclava, Townsend, and Moore, a moderate increase in length and breadth, aided by the fact that the outlines are now far more irregular, creates large increases in length of shore-line, but not always of habitable shore-line. Hurst, Balaclava, and Moore possess deep embayments, penetrating to their centres. Moore is perhaps the smallest in linear measurements, reaching 1½ miles in north-south length by one mile in east-west breadth, but is of a sprawling, subcruciform shape which involves small area and a very long shore-line. It is separated by some six miles of singularly vicious tide-rips from the nearest land (Aristazabal) other than its companion islets. Here in a single night's trapping an unusual number of small areas were tested and all seemed well stocked. An unusually large proportion of the shore line, owing, in this case, to exposure, is favorable, and the island's *Peromyscus* population might well exceed a thousand. Townsend and the remainder of the group are larger and less complex. Townsend is two and a half miles long by an average scant half mile in width. Parts are heavily timbered, and most are heavily covered with salal. Many areas were tried but mice found at only three favorable localities, and the whole population could hardly exceed a few hundreds. It is separated from Smythe, via an intervening islet, by a channel some fifteen yards wide and under a fathom deep at zero tide. No timber comes near enough to this point to create tree bridges. The remaining islands of this order lie between the two as to character and probably as to population.

C. Islands of the Third Order of Magnitude.

This includes islands of several miles, up to six or seven, in greatest linear dimension, such as Hope and Nigei, Goose, or the larger Bardwells. Here we lose all sound basis for estimation of numbers. Certain it is, however, that in spite of the relative increase in total shore-line, the length of the favorable stretches does not increase proportionately, and the trapping is more and more apt to be restricted to the points. Very few islands of this order exist whose inner shores are not steep, wet, and overhung. Large portions are sheltered, either by the body of the island itself or on account of the inner-zone position, and the favorable effects of exposure become relatively slight. While we have had, unfortunately, no time to make a comprehensive survey, more than by casual inspection combined with very spotty trapping, it is not believed that any of this group contain more than one to three thousand *Peromyscus*. Goose may be a notable exception. It is a relatively large island, six miles long and from a half-mile to a mile wide, lying some six miles offshore, low and unprotected, exposed to all the furies of Hecate Strait. It is a large area which yet retains all the advantages of Moore, and possesses far more than Table. The small but varied area tested was, for the region, extremely fruitful.

D. The Large Islands.

Pitt is a parallelogram, fifty miles long, with an average width of ten. Banks is a crescent, roughly forty by eight miles in length and breadth. Princess Royal is a bulky, lopsided oval, forty-five miles long by fifteen at greatest breadth. From these down to the smallest categories just discussed every gradation and character is represented, as roughly indicated on the accompanying small-scale map.

Along the inner shores of Princess Royal and Pitt conditions begin to approach those of the mainland zones, where high timberline represents an appreciable fraction of the whole map area. The high brown grassy areas, which from sea level look like conventional alpine meadows, are none the less for the most part boggy, and their islands of scrub shelter no *Peromyscus*. Along the very crests are large areas of ice-smoothed rock, bordered by a scrub of Mountain Hemlock, wind-racked into a peculiar continuous roof-like habit, open below, beneath which, in summer at least, wolves, bears, and blue grouse live an almost indoor life, on ground admirably suited to maintain a considerable population of *Peromyscus*. At low levels in the zone, as when crossing, afoot or in a canoe, through the valleys, fine bits of well-drained forest-edge, or rocky outcrops well suited to the species, are not infrequent, and a sparse, spotty interior population must be presumed to exist, as it was found to on Calvert. The long, straight stretches of steep, wet, heavily-forested inner shore are very poor, with miles and miles not worth trapping. On the contrary, the greatly indented outer shores,—lower, more exposed, rich in well-drained points, are not only vastly greater in total length, but for the most part very favorable.

A freakish island like Campania, with its great central cone of naked rock, may possibly make up with a mountain population for the proven sterility of its broad surrounding muskegs

The largest islands are often nearly bisected by inlets, which originate from the outer shores, as well as dissected by mountain ranges. With more material and finer work it is not impossible that intra-island variations may appear. We have found no suggestion of this, however, between the populations of Hague Point and Barnard Cove on opposite ends of Princess Royal, or between Union Pass and Captain's Cove, similarly situated on Pitt.

Since the work on *Peromyscus* extended over three years and over so many isolated populations, it does not seem probable that the numerical poverty just described and the sizes of the small populations represent a temporary low level. On the other hand, the bare possibility of such a condition, uniform for all the islands and representing a low point in a swing so slow as not to show much change in so few years, must be taken into consideration, for the mere fact of the continued existence of populations as small as those of the smallest magnitude-group is surprising. Certainly the mere local existence of the species in so variable and turbulent an environment, representing an extreme so far from the average for the genus, bears witness to the amazing vitality and adaptiveness of what is probably to be regarded as the most successful mammalian species of the continent. It is of course conceivable that such populations do not actually persist except by agencies of sporadic replacement, but the evidence of the strong races, and especially of the strongly and complexly differentiated *rubriventer* do not suggest this.

Finally, it is possible that the marginal conditions which keep the numbers down and the distribution sparse are at the same time a safeguard against epidemic maladies, and that the conditions indicated may in this one respect be more favorable than those of environments which otherwise approach the optimum. Evans (1942) has suggested something of this sort. "It is suggested that habitats which will maintain only low densities may be essential to the ultimate survival of a species."

3. *Quantitative Characters*

Definition of measurements:—During preparation of our specimens in the field we took the standard measurements of total length, tail length, length of hind foot, and height of ear from crown. Later it was found that changes in bodily proportions were more readily discernible if we used body length rather than total length in comparison with tail length. Body length figures were obtained from the original data by subtraction.

It was further found that ear length was so highly variable that it was relatively useless for purposes of comparison.

In deciding upon cranial measurements we have attempted to select those that best express the changes in form to which the skull is subject in so far as they are measurable with reasonable accuracy. We make no claim that those chosen are the only ones in which geographic variation could be demonstrated and have borne this lack of exclusiveness in mind during consideration of the implication of our findings. The following measurements have been taken on all skulls of adult aimals:

Greatest length of cranium—measured in a straight line from the posteriormost point on the occiput to the tip of the nasals.

Basilar length of Hensel—greatest distance from the anteriormost point on the ventral lip of the foramen magnum to the posteriormost point on the alveoli of the incisors.

Zygomatic width—greatest width of skull across zygomata.

Interorbital width—least width of interorbital constriction.

Nasal length—greatest length of nasals.

Palatal length—least distance from incisive alveoli to posterior margin of palate on mid-line.

Palatal slits—greatest length of the anterior palatine foramina.

Diastema—greatest distance between plane of anterior surface of anteriormost cheek tooth and posterior surface of incisors.

Maxillary tooth row—greatest length of upper cheek-tooth row.

Post-palatal length—least distance between anteriormost point on posterior margin of palate and anteriormost point on inferior margin of foramen magnum.

Least width of zygomatic plate of maxilla—least width in an antero-posterior direction of the plate of the maxilla forming the external surface of the infraorbital foramen.

All quantitative data have been subjected to statistical examination using formulae set forth by Simpson and Roe (1939). N rather than n-1 has been used in all cases. For each measurement of each population arithmetic mean, standard error of the mean, standard deviation, and its standard error have been calculated. Rough comparison of populations

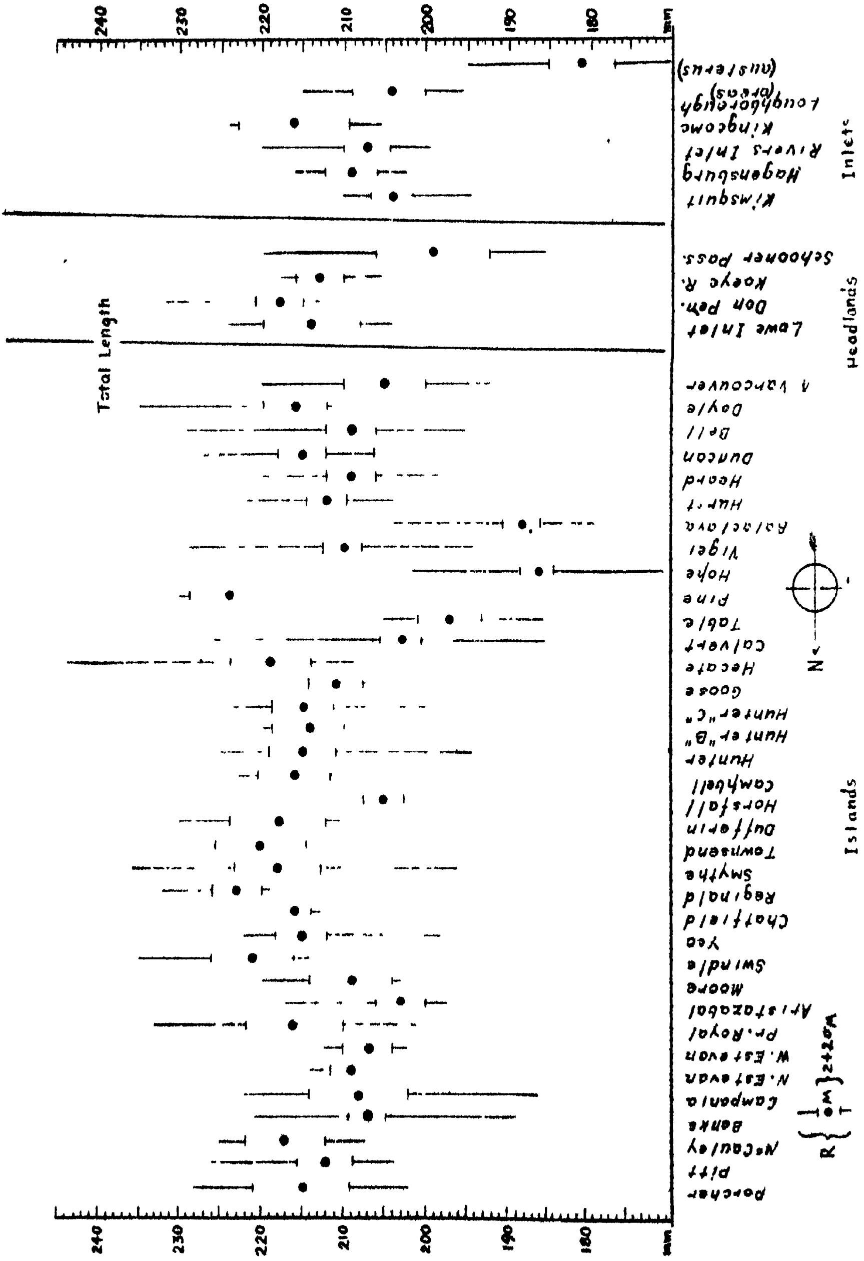

FIG. 4. *Peromyscus*, quantative characters.

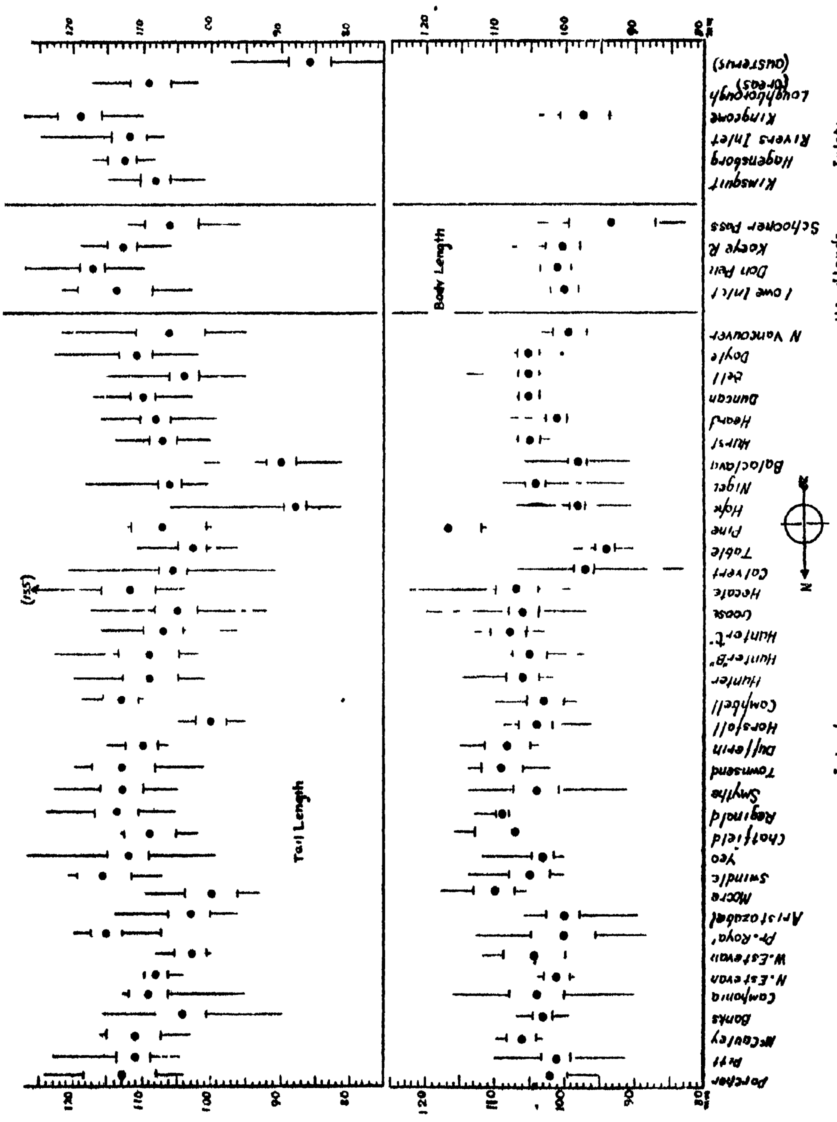

Fig. 5. *Peromyscus*, quantative characters.

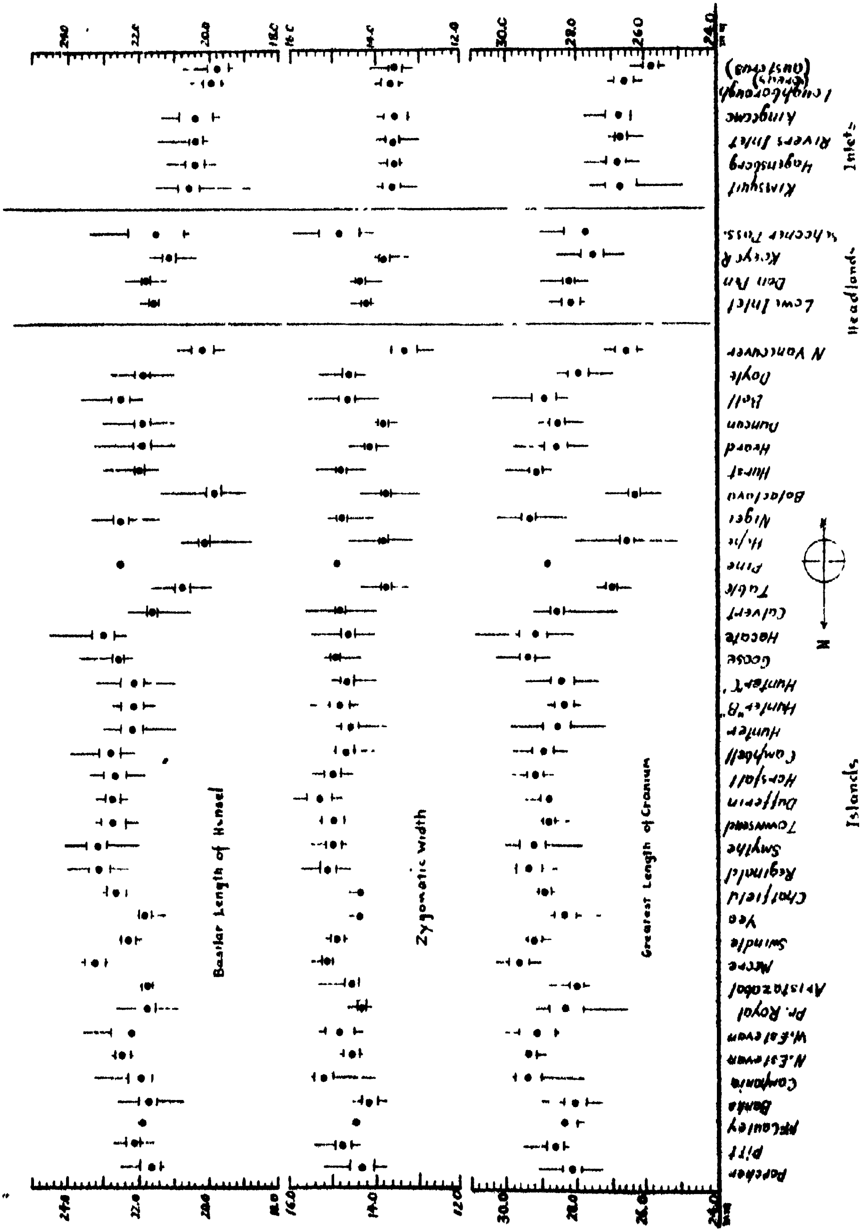

FIG. 6. *Peromyscus*, quantative characters

for significant differences have been made by the Dice-Leraas method, but all differences stated as significant have been subjected to the t-test and found to have a probability value of 1 per cent or less.

4. *Qualitative Characters*

Many of the characters differentiating populations of small mammals are not easily measurable and consequently cannot be subject directly to statistical analysis.

In the present study, form of certain parts of the skull, and external color and pattern, fall into this group.

Our experience with color, particularly as it is represented in the pelage of small mammals, has led us to the conclusion that in most cases precise differences in hue and intensity are not describable with reference to any standard series of pigments. The pelage color will vary with the intensity, nature and direction of the illumination and with the judgment of the viewer. For these reasons we have kept to a minimum reference to Ridgway's *Color Standards and Color Nomenclature.* More often than not such references impart a spurious precision to color descriptions of small mammals.

In the examination of our series we set up a graded series of standards both with regard to body color and to intensity and extent of dorsal stripe. Our body color standards and the insular populations chosen as representing them are: ruddy—Hunter Island; intermediate—Calvert Island; ochre—Table Island; neutral—Aristazabal Island. The same series of islands were found to provide a useful gradation in intensity and extent of dorsal stripe from dark in Hunter Island, intermediate in Calvert, to weak in Table and Aristazabal. All insular and mainland populations were compared with these standards and grouped according to the categories into which they fell. In graphing the results (Fig. 8) we have arbitrarily assigned a weight of one unit to pale color, either ochre or neutral, two units to intermediate color, and three units to ruddy. Similarly one, two and three units were assigned to light, intermediate and dark stripe, respectively.

Thus increased height of column on the graph represents in a diagrammatic way increased intensity of pigmentation in both body color and dorsal stripe.

On this basis the following color categorization of our insular and mainland populations was arrived at.

BODY COLOR:

Ruddy.—Islands—Hunter, Hunter B, Hunter C (=Ruth), Reginald, Smythe, Townsend, Chatfield, Horsfall and Dufferin.

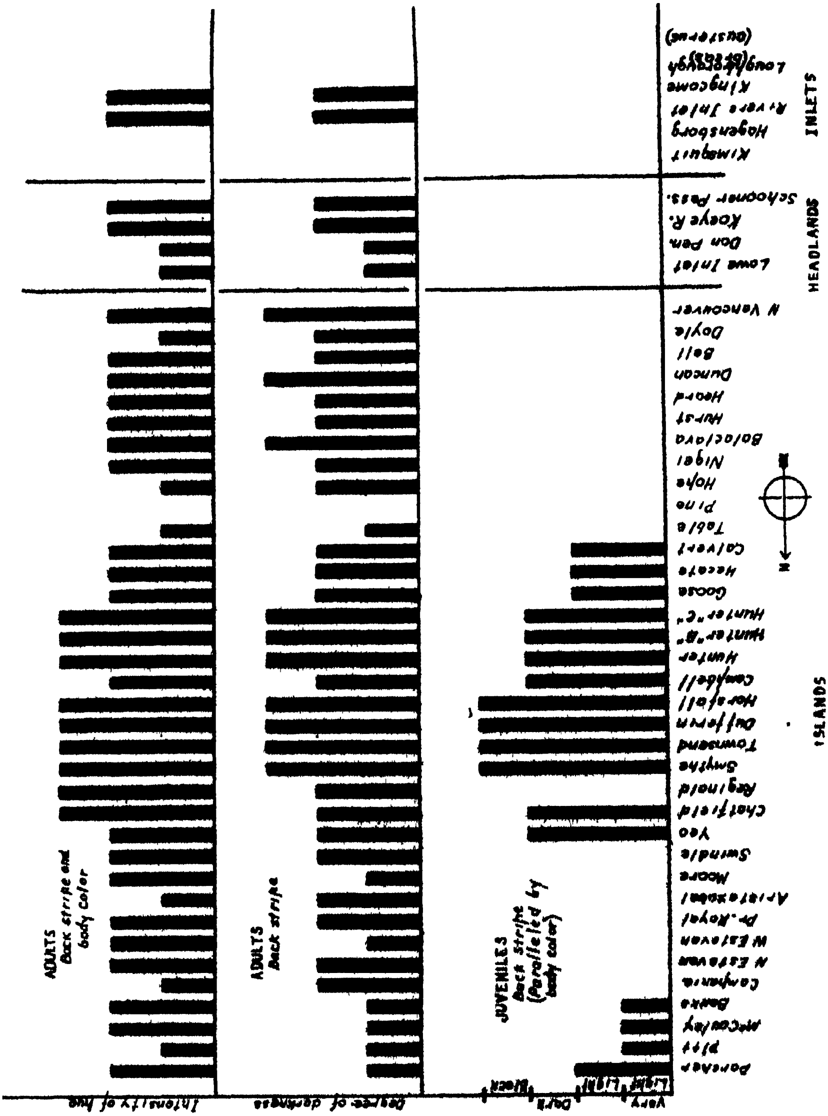

FIG. 7. *Peromyscus*, color characters.

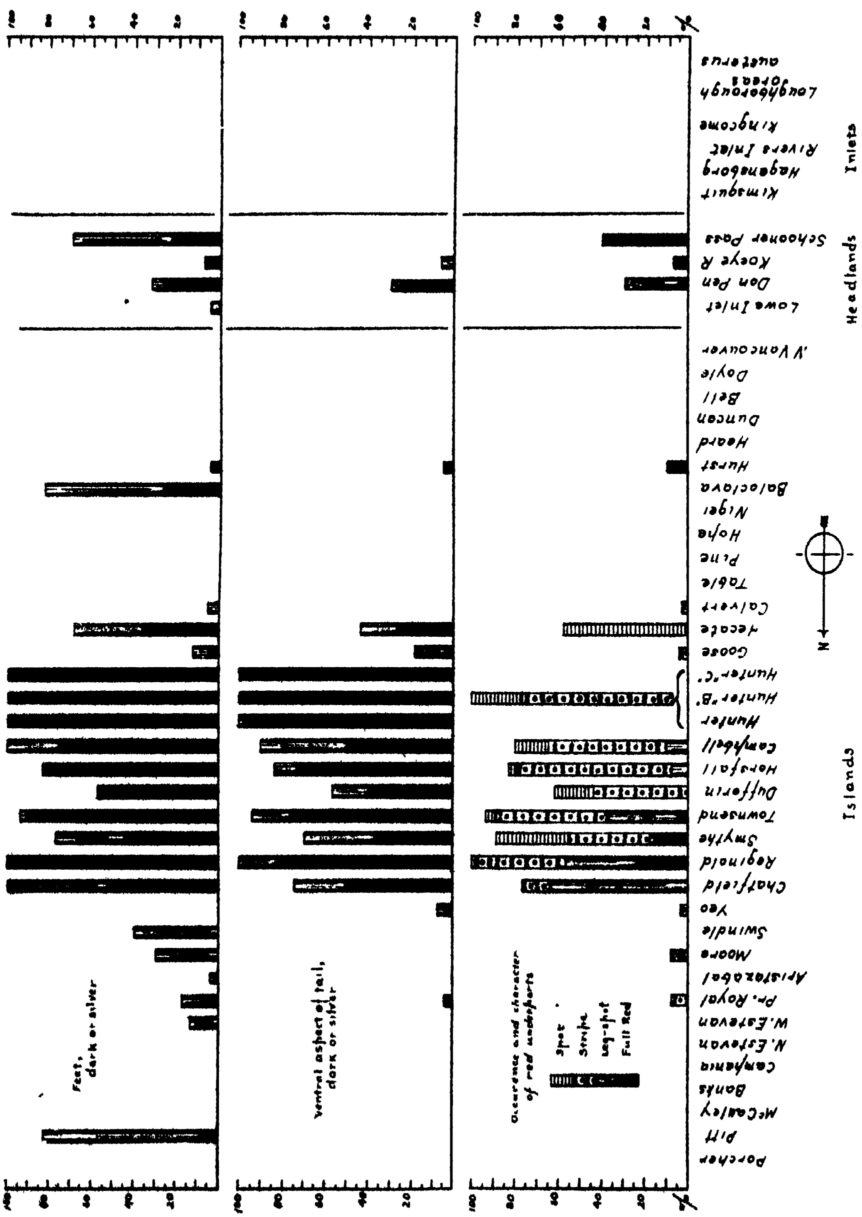

FIG. 8. *Peromyscus*, color characters.

Intermediate.—*Islands*—Porcher, Banks, McCauley, North Estevan, West Estevan, Moore, Princess Royal, Swindle, Yeo, Campbell, Goose, Hecate, Calvert, Heard, Bell, Hurst, Nigei, Duncan, Northern Vancouver. *Mainland*—Koeye River, Beaver Seining Ground, Rivers Inlet, Kingcome Inlet.

Pale-ochre.—*Islands*—Campania, Table and Doyle. *Mainland*—Lowe Inlet.

Pale-neutral.—*Islands*—Aristazabal, Pitt and Hope. *Mainland*—Neckis River and Tom Bay.

STRIPE:

Dark.—*Islands*—Hunter, Hunter B, Hunter C (=Ruth), Smythe, Townsend, Horsfall, Dufferin, Duncan, Balaclava, and Northern Vancouver.

Intermediate.—*Islands*—North Estevan, Princess Royal, Swindle, Yeo, Chatfield, Campbell, Reginald, Hecate, Calvert, Heard, Bell, Hurst, Nigei, Doyle and Hope. *Mainland*—Koeye River, Beaver Seining Ground, Rivers Inlet and Kingcome Inlet.

Light.—*Islands*—Porcher, Pitt, Banks, Campania, McCauley, West Estevan, Moore, Aristazabal and Table. *Mainland*—Lowe Inlet and Neckis River.

In general there was found to be a strong correlation between saturation of body color and intensity of dorsal stripe. Thus the palest populations—those of Pitt and Table islands and Neckis River and Lowe Inlet mainland stations—have at the same time the lightest dorsal stripes. The islands with the most saturate body color—Smythe, Townsend, Dufferin, Horsfall, Campbell, and the three Hunter Islands—have the darkest dorsal stripes. Not one population with pale body color has a dark stripe, nor *vice versa*, but as will be seen from the graph certain populations either light, intermediate or dark in one of these categories fall into a different class with regard to the other.

Although our collections contain juvenal *Peromyscus* from but seventeen island and two mainland stations, it is possible to recognize distinctly different color characters among these. The populations from Pitt, Banks, and McCauley islands are very pale gray with a faint brown wash and an indistinct dorsal stripe.

The single juvenal from Porcher Island is darker and with a steel-gray quality, with the small groups from Hecate, Calvert and Goose Islands and Neckis and Koeye rivers are of about the same intensity but lack the steely quality.

Those from the Hunter Islands and from Campbell, Yeo and Chatfield islands are dark but not as dark as the juvenals from Smythe, Townsend, Horsfall and Dufferin islands. These have the body color very dark and the dorsal stripe coal black. They constitute a highly distinctive population.

The most spectacular departure from the normal color pattern discovered during the course of our field investigations was what we are referring to as red-belly. This character was frequently associated with pigmentation of the dorsal side of the hind foot and underside of the tail. Discussion of the degree of association apparent between these three mutative changes in pigment pattern is given elsewhere in this paper. The distribution of pigment on the normally white abdomen of *Peromyscus* falls into four categories that we have defined as follows:

Full red: Underparts completely suffused with red passing into dorsal body colour without interruption, revealing whites only on fore feet, lip, and occasionally, as explained elsewhere, on the hind feet and tail.

Leg spot: Like the previous but with white spots in the axillae and groins and the white lip spot enlarging to include the chin.

Stripe: Red of abdomen separated from body color by white latero-ventral zones which are confluent enlargements of the spots just described. At the same time the white chin patch spreads posteriorly over the throat and invades, in two lateral lobes, the red chest area. The red ventral stripe may show a longitudinal white division of greater or less extent.

Spotted: Underparts white except for small red spots in the axillae and on the posterior central abdomen.

These are characteristic but arbitrary categories. Intergradation certainly occurs between them.

The complete manifestation of the red-bellied condition in any phase is only visible in the adult individuals. In these, the otherwise white terminal half of the ventral hairs contains this deep brick-red colored pigment. Sometimes the entire white is so pigmented, in other instances a narrow white area persists between a terminal red and basal plumbeous regions. In the juvenal pelage it is still possible to detect the presumptive red animals and to assign them to their correct phase. In them areas of a warm gray hue adumbrate the subsequent red region in sharp distinction from the white areas on the adult, which are white also in the juvenal.

In addition to these phases of color distribution on the abdomen there are also varying degrees of intensity of hue that arise from amount of pigment present in the individual hairs. These we have not attempted to segregate.

For the ventral half of the tail and the dorsal surface of the hind feet we have used three descriptive terms: (1) white, (2) silver, and (3) dark.

White: Indicates hairs completely white only.

Silver: For the feet "silver" may indicate a variable proportion of white hairs with a narrow subbasal fuscous band or a variable proportion of wholly or largely dark hairs. Certain islands, notably Balaclava, run almost exclusively to the latter pattern, but it is doubtful whether any population represents a single sharply exclusive phase. For the ventral half of the tail silver indicates a considerable proportion of wholly dark hairs.

Dark: Whether for tail or foot, dark indicates a preponderance of wholly dark hairs, giving to the naked eye an unbroken effect of dark warm brown. In the hind foot such color extends usually to the base of the toes. In a smaller number of cases the distal third of the foot may be white while the proximal two-thirds is heavily pigmented.

Several minor and local variations, not expressible by measurement, in form of cranium were detected but these were considered of small importance for the purpose of the present study. On the other hand, it was found possible to segregate the populations into groups on the basis of the form of the posterior margin of the hard palate and the size of the posterior palatal foramina.

The form of the posterior margin of palate offers three bold and unmistakable variations which are constant through a large majority of each series: (1) pointed; (2) obtuse, which may be subdivided into rounded and subsquarose; and (3) subcordate or denticulate, with a minute apiculus at the centre of the arch.

On these bases the populations can be divided as follows:

Pointed: Moore, Aristazabal, and Table islands.

Obtuse-rounded: Banks, Campania, McCauley, Pitt, North Estevan, West Estevan, Princess Royal, Yeo, Chatfield, Dufferin, Horsfall, Campbell, Hunter, Hunter B, Hunter C (=Ruth), Smythe, Townsend, Reginald, Hecate, Goose, Calvert, and Doyle islands; Lowe Inlet, Neckis River, Koeye River, Rivers Inlet and Kingcome Inlet.

Obtuse-subsquarose: Princess Royal, Swindle, Duncan, Nigei, Hope, Balaclava, Heard; Beaver Seining Grounds, and Sayward.

Denticulate: Hurst and Bell islands and northern Vancouver Island.

Posterior palatal foramina **show wide variations in size which intergrade between series but are essentially constant within the series. They may be classified into large (about 1.0 mm. in length), minute (pin point), and intermediate. When so grouped it is found that only Doyle Island**

falls in the *large* class; Hope Island, Balaclava Island, and northern Vancouver Island, at the southern extremity of our study area, and Porcher, Pitt, Banks, and McCauley islands, at the northern end of the area, have these foramina *minute*. The remaining populations are intermediate.

5. *Color and Pattern Mutation of Abdomen, Tail and Hind Foot*

Earlier in this paper a brief description of three mutative changes affecting color of abdomen, color of underside of tail, and of dorsal side of hind foot was given. These mutations were detected in the *Peromyscus* stock occupying the outer coast of the mainland at each collecting station from Inverness, at the mouth of the Skeena River to Schooner Passage on the north side of the entrance to Rivers Inlet. They were also found together or separately in 22 of the 35 insular populations of *Peromyscus* but with a very distinct centre of intensity in the Bardswell and Hunter islands and on Campbell Island. In view of the small size of the insular samples and the low frequency of occurrence of the mutations in many areas, it can safely be assumed that these color aberrations occur on other islands where we did not detect them. It is highly significant that these mutations were not found in any of the population samples from the heads of the inlets. These, as is detailed elsewhere, may represent a different racial stock, *oreas*.

There is a high degree of association between the three color aberrations. The extent of this in the different insular and mainland population samples is set forth on the accompanying table, number 3. There is also a geographic association manifested by a concentration of all three mutative changes in the Bardswell-Hunter group of islands where they are associated with other features to characterize a new race.

Taking account of the five different phases of abdomen color, there are 45 theoretical combinations of our three-color aberrations possible. Twenty-five of these have appeared in our specimens and are listed in the above mentioned table. On the graphs of Figures VII and VIII are illustrated the distribution of the aberrations taken individually.

Considering only the occurrence of the various phases of red belly in the entire population, 238 specimens were taken in which this mutation was present in one of its four chief phenotypic phases. As will be seen from table 3, they were very unevenly distributed geographically. Among these the striped phase was the most numerous, followed in descending order by spotted, leg spot, and full red. The respective proportions of the total 238 specimens are 60 per cent stripe, 20 per cent spotted, 13 per cent leg spot, and 7 per cent full red.

When the data are surveyed from the standpoint of association between red belly and dark tail the very high degree of coexistence of these two aberrations becomes apparent. Thus disregarding phase, 86 per cent of specimens with red belly have the tail dark, 9 per cent tail silver, and 5 per cent white. In the case of red belly and dark foot the association is even more complete and corresponding proportions are 90, 9, and 1 per cent.

It is pertinent to note also that 121 specimens were encountered that had one or more phases of dark tail and dark foot represented either together or separately in the absence of red abdomen. As will be seen from table 3 these were part of our samples from 18 of the collecting stations and constituted 50 per cent of the entire sample from Schooner Passage, 73 per cent of that from Pitt Island, and 61 per cent from Balaclava Island. Of the total only just under 1 per cent had the tail dark, 10 per cent silver, 5 per cent had the feet dark, and 92 per cent feet silver.

TABLE III

The geographic distribution in *Peromyscus* populations of red belly, dark tail and dark foot expressed as a percentage of total sample

Abdomen Color	Tail Color	Foot Color	Inverness	Lowe	Neckis	Koeye	Beaver	Pitt	W. Estevan	Chatfield	Aristazabal
Full red	white	dark					10%				
" "	dark	dark	17%		3%						
" "	dark	silver									
Leg spot	dark	dark									
" "	white	silver									
Stripe	"	dark					10%				
"	silver	"									
"	dark	"			9%						
"	white	silver					20%				
"	silver	"									
"	dark	"									
"	white	white									
Spotted	silver	dark				6%		7%			
"	dark	"			12%					50%	
"	white	silver									
"	silver	"								25%	
"	dark	"									
White	white	dark									
"	silver	"									
"	white	silver					50%	73%	13%	25%	3%
"	silver	"			6%						
"	white	white	83%	95%	70%		10%	20%	87%		97%
"	silver	"		5%							
"	dark	"									
N.			6	21	33	16	10	41	16	8	39
			. .	. .	. .	. .	. .	. .	. .	. .	. .
			. .	. .	. .	. .	. .	. .	. .	. .	. .

TABLE III—*Continued*

Abdomen Color	Tail Color	Foot Color	Moore	Princess Royal	Swindle	Yeo	Campbell	Dufferin	Horsfall	Townsend	Smythe
Full red	white	dark									
" "	dark	dark								3%	2%
" "	dark	silver									
Leg spot	dark	dark					4%		8%		2%
" "	white	silver	3%								
Stripe	"	dark									
"	silver	"					13%			15%	
"	dark	"		3%		3%	48%	47%	68%	64%	39%
"	white	silver	3%								
"	silver	"									4%
"	dark	"					4%		4%		
"	white	white									
Spotted	silver	dark									19%
"	dark	"					9%	16%	4%	9%	
"	white	silver		3%							
"	silver	"								3%	2%
"	dark	"					4%				
White	white	dark							2%		
"	silver	"					13%				
"	white	silver	30%	9%	40%	13%		11%	16%	3%	21%
"	silver	"				3%	4%				
"	white	white	64%	85%	60%	81%		26%		3%	7%
"	silver	"									
"	dark	"									
N.			30	35	15	31	23	19	27	33	43

TABLE III—*Continued*

Abdomen Color	Tail Color	Foot Color	Reginald	Hunter	Hunter B	Hunter C (Ruth)	Hecate	Calvert	Goose	Hurst	Balaclava
Full red	white	dark									
" "	dark	dark	56%							11%	
" "	dark	silver									
Leg spot	dark	dark									
" "	white	silver									
Stripe	"	dark									
"	silver	"									
"	dark	"	44%	67%	86%	58%			4%		
"	white	silver						4%			
"	silver	"									
"	dark	"									
"	white	white						2%			
Spotted	silver	dark					11%				
"	dark	"		23%	56%	42%	26%				
"	white	silver					5%				
"	silver	"					16%				
"	dark	"									
White	white	dark									
"	silver	"									
"	white	silver							4%		61%
"	silver	"					5%				
"	white	white					37%	94%	76%	89%	39%
"	silver	"							8%		
"	dark	"							4%		
N.			34	19	7	12	19	69	26	19	39

From the summarized data it becomes evident that there is a higher degree of association between the abdominal phases full red and leg spot and both dark tail and dark foot than there is between stripe and spot and these two other color features. Among the 17 mice representing the phase full red, 94 per cent have tail dark, 6 per cent tail white, and 100 per cent have dark feet. Corresponding proportions for the other three abdominal color phases are leg spot, tail dark 97 per cent, tail white 3 per cent, feet dark 97 per cent, feet silver 3 per cent; stripe, tail dark 86 per cent, tail silver 8 per cent, tail white 6 per cent, feet dark 92 per cent, feet silver 7 per cent, feet white 1 per cent; spotted, tail dark 75 per cent, tail silver 19 per cent, tail white 6 per cent, feet dark 77 per cent, feet silver 21 per cent, feet white 2 per cent.

It will be understood from the above discussion that the degree of association between these characters is very high. In certain populations red belly seems to be present without dark tail. Thus at Beaver Seining Ground 40 per cent of the population had the former while the latter character did not appear. Similarly on Moore Island the 6 per cent of the population with red belly lacks the dark tail which did not appear in the population. The same applies to the 6 per cent with red belly on Calvert Island. Only on Hecate Island, where 58 per cent have red belly while only 53 per cent have red belly plus dark tail, did we find a population in which both characters were present without being universally associated.

Dark foot in either dark or silver phase is even more closely associated with red belly. In only one population did we encounter red belly with white foot; this was on Calvert Island where one specimen was found with this combination. Dark foot without red belly proved to be more common but nowhere occurred alone in a population except in the diluted "silver" phase which represented 61 per cent of the Balaclava Island population. The intermediate "silver" phenotype in tail color and foot color is produced by two conditions. In the first a few all-dark hairs are present. In the second varying numbers of hairs are dark basally and become white at the tip.

6. *General Taxonomic Position; the Surrounding Races*

Along the mainland coast from Lowe Inlet in the north to Rivers Inlet in the south as represented by our series from these two points and Neckis River, Kimsquit, Hagensborg, Koeye River, and Schooner Passage, there is an over-all uniformity in color. The two series named as the geographical extremes are almost inseparable in color except for a slight intensification of the dorsal band to the south. In this feature the Hagensborg and Koeye River series are closest to the Rivers Inlet group. The Neckis River sample tends to be slightly darker both in hue and in dorsal stripe– a tendency that is carried still further in the small series from Beaver Seining Ground where the saturation in body color is adumbrative of the condition found in the race *rubriventer* on adjacent islands to the north.

Comparison with a series of six topotypes of *macrorhinus* reveals an over-all agreement in body color and in dimensions, external and cranial. The Lowe Inlet population has the dorsal stripe paler than the topotypes; the Neckis River series is, on the average, more saturate in body color. The Kimsquit series is identical as regards body color

Comparison of populations from the heads of the inlets as represented by the series from Kimsquit, Hagensborg, Rivers Inlet, and Loughborough Inlet with our series from the outer coast at Lowe Inlet, Neckis River, Koeye River, and Schooner Passage reveals that the more inland populations are usually smaller in total length, tail length, body length, and several cranial regions.

There is a corresponding decrease in size of skull which is of significant degree in greatest length of cranium, basilar length of Hensel, zygomatic width, palatal length, palatal slits, diastema, and post-palatal length, or six of the eleven measured features. These cranial differences are derived from comparison of the Neckis River and Kimsquit series. There are minor deviations from the precise features displaying significant differences when other pairs of inner and outer coast populations are compared. Thus in tail length the Hagensborg and Rivers Inlet populations are not significantly different from the outer coast populations at Koeye River.

The Loughborough Inlet population is referable to *P. m. oreas* from the mean of which it departs only in slightly darker color. The Neckis River and Lowe Inlet series are plainly referable to *macrorhinus*. However the above comparison of inner and outer coast populations introduces problems of interpretation. The Schooner Passage series, as is discussed elsewhere, cannot be considered as representative of the outer coast. *Peromyscus*, *Sorex*, and *Clethrionomys* populations here all indicate the results of virtual insularity. Nevertheless the Koeye River series in external dimensions, other than body length, is smaller than the northern series and thus shows approach to *oreas*. Cranial dimensions are approximately intermediate between those of the two races. No submergence could have cut off Koeye River or made an island of its surroundings. In general there is a trend toward increased size northward in the inner coast populations and toward decreased size southward in the outer coast populations, with the outer coast populations of larger dimensions at any given latitude. Not all the characters vary together. Thus the Kimsquit population has the large foot of *macrorhinus* but is otherwise closer to *oreas*, while the Rivers Inlet population approaches *macrorhinus* in length of tail, is intermediate in total length, and nearest *oreas* in cranial dimensions and length of hind foot.

This all suggests that we may be dealing with a gradual intergradation between two races with the characteristics of *macrorhinus* extending south along the outer coast far south of the northernmost inner coast point at which the population is referable to *oreas*.

However, there are other possible explanations. The *Peromyscus* population to the east of the Coast Range mountains is *artemisiae*, a small, pale-colored, short-tailed race. The inlets from the heads of which our inner coast series were taken continue through the mountains as river valleys with low-elevation passes. Consequently it is possible that the characters exhibited by the populations at the heads of the inlets are the product of intergradation down the valleys between *artemisiae* and *macrorhinus* and that the population at the head of each inlet is the result of a somewhat isolated racial admixture. Such an origin would quite possibly produce the existing variability in these inner coast series from different localities.

The environmental conditions of the heads of the inlets have fostered the development of a *Peromyscus* with characters different from those of the outer coast, but this would have taken place independently at the head of each inlet, with some degree of local divergence.

On the basis of existing information it is not possible to determine which of these alternative explanations is the most probable or whether all are operative at different points. Extension of collecting inland along the rivers entering the heads of the inlets and collecting at higher altitudes both on the outer and inner coast will be necessary before conclusive decisions can be made.

A series of specimens from Stuie, B.C., fifty miles up the Bella Coola valley east of Hagensborg, plainly shows intergradation with *artemisiae*. Certain specimens are ultratypical of that race. Others are apparently *oreas*, and still others are intermediate. However, the characters distinguishing *artemisiae* from *macrorhinus* are such that intergradation resulting in intermediate conditions might well be virtually indistinguishable from *oreas*.

South of Rivers Inlet we have series from Kingcome Inlet, Loughborough Inlet, Bute Inlet, and from Horseshoe Lake in the vicinity of Powell River, and from the Vancouver district. In the latter region the small, short-tailed, dark race *austerus* is characteristic of low elevations along the coast while the light colored, long-tailed *oreas* is the inhabitant of the higher elevations. The transition involves intergradation through a narrow region. The Horseshoe Lake population is typical *austerus*, but the Loughborough Inlet series demonstrates a recognized but unusual condition. Here both *oreas* and *austerus* occur together at sea level and apparently without intergradation. The series of 21 specimens from this site is divisible into two mutually exclusive groups on basis of tail length alone. Eight individuals with external dimensions, total length 204 (195-215), tail 109 (102-117), hind foot 22.8 (22-24), are easily separable from thirteen specimens in which the corresponding dimensions are 181 (170-195), 86 (75-97), 21 (20-22), and an examination of the skins reveals that the same grouping segregates the entire sample into two color groups corresponding to the two races. The Kingcome Inlet series is referable to *oreas* as regards cranial measurements but in external dimensions is noncommital, and in color approaches closest to *macrorhinus*. It undoubtedly illustrates the results of intergradation between these two races. The small series from Bute Inlet indicates a condition identical with that at Loughborough.

7. *Variation within the Area*

On the twenty-nine islands from which we have specimens, north of Queen Charlotte Strait and south of Dixon Entrance, the *Peromyscus* populations fall into two major groups. One group centered about the Bardswell and Hunter island groups is characterized by the extreme of saturation in body color and blackness of dorsal stripe, and by the appearance of red pigment upon the abdomen, dark pigment on the underside of the tail and upper surface of the hind foot, and minor cranial differences. This population is described as a new race later in the present paper. Our series from Hunter, Ruth, Hunter "B," Reginald, Smythe, and Townsend islands present the above characteristics at their optimum but the *Peromyscus* from Campbell, Dufferin and Horsfall islands are but slightly less distinctive and the Chatfield and Hecate island series also fall closer to the mean of this group. The Yeo Island population is almost exactly intermediate in the characters of body color and dorsal stripe but lacks the abdomen, tail, and foot characters of the Hunter-Bardswell mice.

The second group of insular populations for the most part approach the mean of mainland *macrorhinus*. From island to island there are slight variations in body color and in the intensity of the dorsal stripe but there are few of them greater than corresponding variations remarked upon in discussion of the samples of *macrorhinus* of mainland origin. As regards external dimensions these insular populations where they differ from the mainland outer coast population do so in having shorter tail. This is the case in eight of the fourteen islands considered (table 4). In one island, Moore, the body length is significantly greater; in another, Calvert, it is possibly significantly less. In the same way, with the single exception of Calvert Island, the insular populations in this group that differ significantly from that of the outer coast do so in having the major features of the skull larger; the degree to which this size difference is exhibited and the number of measured features involved varies from island to island.

In general the larger islands closer to the mainland support a *Peromyscus* population either identical with the mainland population of *macrorhinus*, as is the case on Porcher Island, Princess Royal Island, or differing significantly from *macrorhinus* in but few characteristics. Thus on Pitt Island, of the eleven measured cranial features, only basilar length of Hensel is possibly less (P =.03) and zygomatic width greater. On King Island tail length is less. On Banks Island tail length is less and the nasals longer (P = less than .01 in each case). The Swindle Island population has skull larger in greatest length, tooth row and width of zygomatic plate of the maxilla. Certain other islands, while not as large or as near the mainland as those already mentioned, still support a population that has profited but little from the possibilities of change presented by their insularity. In this group are McCauley Island on which the *Peromyscus* differ significantly from *macrorhinus* only in greater width of zygomatic plate of maxilla and possibly in shorter tail P =.02; North Estevan with tail shorter and skull larger in greatest length and basilar length of Hensel; Aristazabal differing more widely with tail shorter and nasal length, palatal length and diastema shorter; as does the Calvert Island mouse in which tail is markedly shorter, the skull broader across the zygomata, and the palatal slits shorter.

Three islands, two of them Goose and Moore, among the most isolated, support *Peromyscus* that, while they present but slight color differences from coastal *macrorhinus* and its insular populations, possess the most radical departures from that race in tail length and cranial characteristics. On Campania Island tail length is actually and relatively much less, ratio of tail length to body length 100 per cent rather than 114 to 116 per cent in mainland *macrorhinus*, and skull is larger in greatest length, basilar length of Hensel, zygomatic breadth, post-palatal length, and width of zygomatic plate of maxilla.

The Goose Island *Peromyscus* have the tail shorter and the body averaging longer (P = less than .01), ratio tail length to body length 99 per cent as against 114 to 116 per cent, and at the same time the skull greater in greatest length, basilar length of Hensel, zygomatic width, interorbital width, nasal length, diastema and width of zygomatic plate of maxilla, or 7 of the 11 measured regions.

The Moore Island population is even more strongly differentiated. It has the greatest mean body length and the shortest mean tail length encountered. Both differences are significant, and render the tail to body length ratio only 91 per cent as against the 111 per cent to 116 per cent in *macrorhinus*. On this island also the skull is larger in greatest length of cranium, basilar length of Hensel, zygomatic width, interorbital width and post-palatal length; all are significant in spite of the small size of the sample (8 adults). In addition all other cranial measurements average larger except length of palatal slits, which are shorter, but these differences are not of significant magnitude.

In many characters, particularly of the skull, these two populations have taken parallel courses and are virtually indistinguishable; however, tail length and color render them easily separable.

From the standpoint of the systematist the *Peromyscus* on Porcher, Princess Royal, and King islands are *macrorhinus*, those on Banks, Pitt, Swindle, McCauley, North Estevan, Calvert, and Aristazabal are *referable* to *macrorhinus*. The West Estevan and Campania populations are almost precisely intermediate between *macrorhinus* and the Moore Island mice. These assignments for the purpose of systematic convenience will not obscure from the student of speciation the varying amounts of change that the insular populations now display.

In the Smith Sound area only one of several small islands was collected upon, but this one, Table Island, bore in some ways the most strongly differentiated single-island population encountered. Its differences from adjoining mainland populations are set forth in detail later in this paper.

Adjoining the northeastern tip of Vancouver Island, and separated from it by two to three mile wide Goletas Channel, is a cordon of seven islands. From northwest to southeast these are Hope, Nigei, Balaclava, Hurst, Heard, Bell, and Doyle; another one, Duncan, is set between these and Vancouver Island at the southern end of the chain. *Peromyscus* were taken on all these and, when compared with one another and with mice from adjoining Vancouver Island, present a startlingly unorthodox complex of variation and distribution. On Doyle Island is a large, brightly colored mouse with several unique cranial characteristics. On Duncan, Hurst, Bell and Heard islands are long-tailed mice of large size but among the darkest of any populations encountered and with a body color of cold hue not elsewhere associated with a *Peromyscus* of this size. On Balaclava and Hope islands the mice are very small with short tails and appropriate skull dimensions and associated with these size characters the same cold, dark, dorsal color found on the adjacent islands. Finally, on Nigei Island is a population differing from *macrorhinus* in slightly larger hind foot and in certain cranial characteristics. In all of these features it approaches the population on Pine Island described by one of us (Cowan 1935) as *Peromyscus sitkensis isolatus.* It seems best to refer the Nigei Island *Peromyscus* to *isolatus* which is now realized to be a race of *Peromyscus maniculatus* resting on questionable grounds because of the inadequate series available. At the time the original description was published lack of pertinent specimens rendered impossible the realization of the actual characteristics and range of variation displayed by the populations now referred to *macrorhinus.* Our subsequent collections have forced a revision of ideas regarding the specific characters of *Peromyscus sitkensis.*

On the basis of information now available *sitkensis* stands as a weakly characterized species, with its most outstanding features a very large hind foot and a short ear. Even in these there is overlap in foot size between the *sitkensis* population on Chichagoff Island, mean of 24.4 (24-25), and the *maniculatus* population, as for example on Nigei Island 25 (24-26). An examination of the baculum of *sitkensis* might yield a further useful criterion for species diagnosis.

Here then at the northern debouchment of Queen Charlotte's Straits we find the most highly variable population of the entire coastline. It is interesting and perhaps significant to note that, within reach of the tidal currents that bear drift piles back and forth across this region are populations possessing most of the characters that have appeared in these

TABLE 4

DIFFERENCES IN BODY DIMENSIONS OF INSULAR POPULATIONS FROM THE MAINLAND OUTER COAST POPULATION

(Differences are all significant)

Island Population	Body			Tail			Foot		
	greater	equal	less	greater	equal	less	greater	equal	less
Porcher		x			x			x	
Pitt		x			x			x	
Banks		x				x		x	
McCauley		x			x			x	
Campania		x				x		x	
N. Estevan		x				x	x?		
W. Estevan		x				x		x	
Princess Royal		x			x			x	
Swindle		x			x			x	
Aristazabal		x				x		x	
Moore	x					x	x		
King		x				x		x	
Goose		x				x		x	
Calvert			x?			x		x	

strongly marked insular races. Thus large size is characteristic of *macrorhinus;* pale bright color of *oreas;* large size, saturate color, and large feet of *isolatus;* and small size with dark, cold color of *austerus.* Only the unique cranial features of the Doyle Island mice are not represented in some combination within ninety miles of these islands. Is it not possible that we have here, where raft transportation should be at its most effective, the results of the landing of individuals of each of these races and the recombination of their characters subsequently fixed by isolation, and supplemented by unique features developing *in situ* to the end that several new and stable populations have arisen?

Peromyscus maniculatus cancrivorus

Type: Male adult, number 2060 British Columbia Provincial Museum; taken June 9, 1937, on Table Island, Queen Charlotte Sound, B.C., by T. T. and E. B. McCabe.

Distribution: Confined to Table Island.

Diagnosis: Smaller, with shorter tail and hind foot and with skull significantly smaller in greatest length of cranium, basilar length of Hensel, zygomatic width, nasal length, palatal length, palatal slits, and least width of maxillary plate of zygoma than corresponding measurements of *macrorhinus.* Coat color the palest extreme in the ochraceous series of populations, with the dorsal stripe suppressed to its minimum, no graying on the head, no dusky eye ring, and with a manifest tendency for the color of the front of the fore limb to extend completely around the ankle and even to appear as a suffusion on the breast.

Specimens examined: Nineteen, all adults, taken in early June.

Remarks: The coloration of this race is completely unlike that of any other race known to occur in British Columbia. The bright ochraceous tone extending even onto the head and face, together with the paleness of the dorsal stripe, set the race apart among a mixed group. Table Island is among the smallest of the islands worked by us and the presence on it of so distinctive a *Peromyscus* population may testify to the effectiveness of the isolating factors.

In cranial characteristics *cancrivorus* is much more like the population inhabiting the coast of British Columbia further south in the region of Kingcome Inlet. Here the *Peromyscus* are referred to *P. m. oreas* though they differ slightly from the mean of this race. From this population of *oreas, cancrivorus* differs in smaller body length and tail length, and in longer maxillary tooth row. The color once again makes distinction easy. The closer size correspondence between the Table Island population and those of the mainland coast between Kingcome Inlet and Loughborough Inlet than between *cancrivorus* and *macrorhinus* may point to a southern origin for the original population to reach Table Island. This hypothesis is given further weight by the tendency of *macrorhinus* to increase rather than decrease in dimensions under conditions of close isolation, a tendency dealt with more fully elsewhere.

Peromyscus maniculatus rubriventer

Type: Adult female, number 3888 British Columbia Provincial Museum; taken July 11, 1939, on Ruth Island, the small westernmost member of the Hunter Island complex, by I. McT. Cowan.

Distribution: Taken on Ruth, Hunter, Hunter "B," Smythe, Townsend, Reginald, and in slightly modified form on Campbell, Dufferin, and Horsfall islands. The Hecate Island and Chatfield Island *Peromyscus*, while intermediate, are closer to this race than to *macrorhinus*.

Diagnosis: A large *Peromyscus* (see Figs. 4, 5 and 6), but the size differences from *macrorhinus* are not pronounced. As it occurs on the Hunter Islands (including Ruth Island), *rubriventer* has a larger body, shorter tail, and has the maxillary plate of the zygoma broader than in *macrorhinus*. There are other local differences in skull measurements of significant magnitude but none of these are uniform throughout the area upon which the distinctive color characters obtain.

Body color darker (more saturate) than in any other population encountered; dorsal stripe fuscous, darker, better defined, and more extensive than in any other population; eye ring and whisker spot prominent. Abdomen either entirely red or with red spots or stripes in 100 per cent of the individuals taken on Ruth, Hunter, Hunter "B," and Reginald islands, 94 per cent on Townsend, 82 per cent on Horsfall, 80 per cent on Campbell, 78 per cent on Smythe, 76 per cent on Chatfield, 61 per cent on Dufferin, and 58 per cent on Hecate islands. In the majority of individuals (100 per cent on Ruth, Hunter, Hunter "B," and Reginald islands) underside of tail and upper surface of hind foot are darkly pigmented (see page 108 *et seq.*).

Juvenals in first pelage differ strikingly from all others taken in their dark body color, and coal-black dorsal stripe, as well as in their abdominal, tail and foot color pattern.

Specimens examined: 248 as follows: Hunter Island 19, Ruth Island 13, Hunter "B" 7, Reginald 35, Smythe 45, Townsend 33, Horsfall 28, Dufferin 18, Campbell 23, Hecate 19, Chatfield 8. All in the British Columbia Provincial Museum.

Peromyscus maniculatus doylei

Type: Adult female, number 3784 British Columbia Provincial Museum, taken on Doyle Island (Gordon group), B.C., June 24, 1939, by T. T. and E. B. McCabe.

Distribution: So far as known confined to Doyle Island. Adjacent to the northern tip of Vancouver Island.

Diagnosis: Significantly greater than the *Peromyscus* of adjoining Vancouver Island in body length, greatest length of cranium, basilar length of Hensel, zygomatic width, least interorbital width, nasal length, palatal length, palatal slits, diastema, maxillary tooth row, post-palatal length, and width of maxillary plate of zygoma. Cranial features, unique so far as our studies are concerned, are the strong overhanging lambdoidal crest and the very large posterior palatine foramina. Body color brighter, more ochraceous, and dorsal stripe darker and better defined, cheeks same color as sides rather than distinctly grayer. Eye ring and whisker spot strong and concurrent rather than almost absent.

Specimens examined: Fifteen, all from Doyle Island.

Remarks: Compared with *macrorhinus* of the mainland, *doylei* is of much the same general proportions. The body length is greater— probably significantly so ($P = .02$)—and the interorbital width and length of palatal slits are both significantly greater. The lambdoidal ridge and large posterior palatal foramina are as distinctive in this comparison as in the last. The color differences are similar to those already described.

Peromyscus maniculatus balaclavae

Type: Adult male, number 3838 British Columbia Provincial Museum, taken June 12, 1939, on Balaclava Island, B.C., by T. T. and E. B. McCabe.

Distribution: Balaclava Island and Hope Island of the Gordon group adjacent to northern Vancouver Island, B.C.

Diagnosis: The smallest insular race encountered. In body length identical with the population of *interdictus* on adjacent Vancouver Island but with the tail so much shorter that the total length is also significantly less. Ratio of tail length to body length, 92 per cent as against 107 per cent. The hind foot in *balaclavae* is significantly shorter. There are no cranial differences apparent between these populations. Color, on the other hand, is diagnostic; in *balaclavae* both body color and dorsal stripe are almost identical with those of topotypical *saxamans* and as in that race differ from those of the northern Vancouver Island population in being markedly darker, and with the sides of colder hue. Topotypical specimens have the dorsal surface of the hind feet "silver," i.e. masked with brown, in 61 per cent of their sample. This is not the case on any of the adjacent islands.

Specimens examined: 75 as follows: Balaclava Island 32, Hope Island 43.

Remarks: This race most closely resembles *austerus* as the latter race occurs at Loughborough Inlet. From the latter population *balaclavae* can be distinguished by the more saturate body color, the warm tone and diffuse nature of the dorsal stripe, which in *austerus* is almost if not quite black and well defined, and by having the total length and tail length and body length greater (P = less than .01, .05, and .05 respectively), and in the longer skull (P = less than .02) with longer nasals (P = less than .01), and narrower maxillary plate of zygoma (P = less than .01).

The close similarity between these two races renders almost inescapable the conclusion that the ancestral stock reaching Balaclava and Hope islands had an origin similar to that of present day *austerus*.

Peromyscus maniculatus saxamans

Type: Adult female, number 3799 British Columbia Provincial Museum, taken June 22, 1939, on Duncan Island, B.C., by T. T. and E. B. McCabe.

Distribution: Duncan and Heard islands and in slightly modified form on Bell and Hurst islands all of the Gordon group, British Columbia.

Diagnosis: Size large, in external dimensions (Duncan Island series) significantly greater than the sample from adjacent Vancouver Island in body length, total length and length of hind foot. In cranial dimensions *saxamans* is larger than the Vancouver Island population in all save length of maxillary tooth row and least width of maxillary plate of zygoma in both of which the two populations are indistinguishable; posterior palatine foramina larger.

In color very dark, the darkest population taken with single exception of *rubriventer*, but sides with a cold hue rather than a warm saturation as in the latter race; dorsal stripe broader and darker than in the Vancouver Island population but the darkest adolescents of the latter approximate the palest adult *saxamans* in color.

Specimens examined: 71 as follows: Duncan Island 15, Heard Island 16, Hurst Island 19, and Bell Island 21.

Remarks: *P. m. saxamans* is nearest to *doylei* in cranial characters and external dimensions. In the latter, the two races are indistinguishable, but cranially the former has the zygomatic width and least width of maxillary plate of zygoma less and it differs further in the smaller posterior palatine foramina, much less prominent lambdoidal ridge, and in having the posterior tip of the nasals acute and extending markedly posterior to the premaxillae rather than obtuse and ending almost if not quite in line with the posterior tips of the premaxillae. In the latter feature the Vancouver Island Hardy Bay-Cape Scott population displays an intermediate condition. Color differences between *doylei* and *saxamans* are striking, the pale ochraceous body color of the former being in strong contrast with the cold brownish gray of the latter.

In comparison with the mainland population of *macrorhinus*, *saxamans* is of similar external and cranial dimensions except for the narrower zygomatic width and zygomatic plate of maxilla which served also to distinguish the present race from *doylei*. There is no overlap in color characters between our mainland series of *macrorhinus* and the Duncan and Heard Island series of *saxamans*.

Peromyscus maniculatus maritimus

Type: Male adult, number 3010 British Columbia Provincial Museum, collected September 12, 1938, on the largest of the Moore Islands, B.C. (52° 38′ N. and 129° 28′ W.) by T. T. and E. B. McCabe.

Distribution: Known only from Moore Island.

Diagnosis: Color as in *macrorhinus* but tail shorter and body longer, ratio tail to body 91 per cent instead of 114 to 116 per cent at Lowe Inlet and Neckis River respectively. Skull significantly larger than in *macrorhinus*, in greatest length, basilar length of Hensel, zygomatic width, interorbital width, and post-palatal length.

Specimens examined: 28 all from the type locality.

Peromyscus maniculatus pluvialis

Type: adult male, number 3910 British Columbia Provincial Museum, collected July 11, 1939, on the northern island of the Goose Island group (52° N., 128° 31′ W.) by T. T. and E. B. McCabe.

Distribution: Confined to the type locality.

Diagnosis: Distinctly more saturate in body color than *macrorhinus* of the mainland coast, with dorsal stripe averaging darker than topotypical examples of that race, but about as in the Neckis River population. Tail shorter than in *macrorhinus* and body possibly longer, ratio tail to body 99 per cent rather than 114 to 116 per cent. Skull larger in both length measurements, zygomatic width, interorbital width, nasal length, diastema, and width of zygomatic plate of maxilla.

Specimens examined: 26, all from Goose Island.

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SECTION V

THE MEANING OF THE GEOGRAPHIC PATTERN

1. *Red Underparts, Dark Extremities, and Saturate Pigmentation*

It is a truism that insularity in a biological sense has no necessary connection with islands in a geographic sense. It is a somewhat less familiar proposition that biological variation, because it happens to pass over one or more islands, need not be interpreted in the light of its geographic insularity.

The regional complex just described possesses a distinction from the common run of geographic *Rassenkreise*, large or small, in that, in place of more or less continuity of habitat and contact, the regional population is sharply fragmented into a larger number of small, discrete units than is often, if ever, the case among the higher vertebrates of continuous land areas. It is with the peculiar results of such fragmentation, especially in the light of its youth, that the writers are primarily concerned. Just in so far as such results are distinct from the usual form of omnipresent intergradational blending, they possess peculiar interest. A gradual inter-island or intra-island swing, on the other hand, would hardly differ from any commonplace or mainland variation.

Suppose, however, that a coherent and isolated group of islands possessed, more or less exclusively and uniformly, some character or combination. This again would constitute true biological insularity. It is less satisfactory, less beautifully concrete and delimited, than a one-island endemism. Problems of time for, and means of, transport lend it a certain remoteness, since simultaneous occurrence of identical phenomena on all the units of one exclusive group is hardly to be considered. But the principle is the same.

Finally, to drive an overworked supposition still farther, if it were demonstrable that in recent geologic history such an island group had been a continuous land area, or, conversely, had all been submerged but one small, persistent fraction, either circumstance would enhance the significance of the picture. The first for obvious reasons, the second because the temporary channelizing of the ancestral strain through a small, insulated population, from which the younger islands were colonized as they appeared, would enormously increase the mathematical probability that the present large, final population might owe its character to indigenous mutation under conditions extremely favorable to the preservation of mutation. The existence of a narrow historical bottle-neck would endow the whole present population with all the genetic potentialities of small insularity.

In point of fact, not only does a notable example of such island-group endemism occur, but one which satisfies the last supposition. This is the complex of the red bellies, dark extremities, and saturate pigmentation, which reaches a startling maximum on the Bardswell-Hunter island group. The situation is the more comprehensible for two circumstances. First, the broad confinement between the most obvious inter-island barriers, Queen Charlotte's and Milbanke sounds, the former reinforced by Hakai Pass. Second, the fact that the recent four hundred to six hundred foot submergence would have drowned, or left awash, like hundreds of fringing reefs today, most of this miniature archipelago, leaving, or leaving habitable, only the small, steep mountain on the north end of Hunter Island, with doubtful high spots on Campbell Island. Hecate Island, where the red and extremity characters occur in reduced frequency, is mountainous, and would have been little changed, but considering its marginal position, the near absence of the characters on Calvert (of which Hecate is a mere half-embraced fragment), and the vicious character of Hakai Pass, Hecate can hardly be thought of as the citadel and source of the characters in question.

There is, on the other hand, no evidence that these islands have ever, by any further elevation, actually been united to one another. McConnell (1914), on Texada Island, and Johnston (1923) in criticism of Daly, among others, are very convincing as to the continuity of recent elevation and subsequent stability, which implies that the present elevation represents a maximum. None the less, it is worth remembering that an oscillation of only a few feet would have connected, however deviously, every unit of the Hunter-Bardswells.

Since we are dealing with a natural phenomenon, the endemic character of the group variation is hardly a matter of precision. Red bellies, dark feet, and dark tail are not exclusively confined between the Sounds, nor do they fill the areas between them with unimpaired frequency. Calvert shows near-obliteration, as though the narrow, quiet passages around Hecate had barely been forded, or as though the larger population had for some reason been slow to assume the new complexion. Hecate itself, lying beyond Hakai Pass, shows greatly reduced frequency. Far to the south Balaclava and Hurst, to the north and to seaward Princess Royal, the Moores, and Goose, show minute percentages of red, while Pitt, Aristazabal, Swindle, and the Estevans show larger percentages of dark or silver feet only. More important, both the red and extremity characters are shared, though in greatly decreased frequency, with the adjacent headlands. None the less, figures show better than any words the fact of the essential, massive, geographic unity of the phenomena.

If, as seems obvious in the case of a small area of extreme geologic youth showing only superficial variations, we take degree of prevalence and intensity as criteria of indigenous antiquity—i.e., if we accept the centre of intensity as the point of origin—we are led directly into a singularly clear and substantial hypothesis. At some time during or after the withdrawal of the ice-cap but previous to the subsequent elevation of the coast there developed somewhere within the Hunter-Bardswell area the immense tendency to mutation in the direction of spread and intensification of pigmented areas which the present population exemplifies. Since the most probable mode by which such a tendency could so rapidly achieve such a degree of strictly local prevalence is through small population-number and isolation, and since this is a region above all others of small isolated populations, we are probably not taking too great a liberty in assuming that such was the mechanism which, so to speak, concentrated the genetic results. This is rendered the more probable by the high post-glacial shore-line, with far greater isolation of such islands as then existed, and the transformation of many of the present headlands into islands. But it is possible to go farther than this in reconstruction of the ancient scene and the framework of this natural experiment in racial genetics.

It happens that the whole of the Hunter-Bardswells are extremely flat, with one striking exception, the single perfectly isolated peak, which we shall call Hunter Mountain, which rises from the north shore of Hunter Island proper. A few points on Campbell might also have stood above water, but not enough to have supported a population. The slopes of Hunter Mountain then rose straight out of the sea, some two to four miles in diameter, looking southward to the dim ranges of Calvert and Hecate and northward to those of Swindle and Princess Royal over unbroken waters or waters afoam with breaking reefs, but east much as at present across the gusty tide-rips of Fisher Channel to the mainland, where the white rim of the ice may still have been visible, sending glacial tongues to the sea. It constituted a small and well-isolated island, squarely off the mouth of one of the largest inlet-systems of the whole coast and close to the mouths of two others with their fast tides and concentrated drift. Judging from its present advanced degree of forestation, to the very summit, it was well in the lead in the race for a soil and some degree of vegetable cover. Here, in the midst of the present range, was a perfect apparatus for the isolation and transformation of an ancestral population.

There followed the elevation of the reefs in all directions, and the drying of the shallowly-submerged piedmont plateau block, from Hakai to Milbanke, with its relatively quiet, shallow, tortuous channels, which in rare spots might be only a few feet deep and narrow enough to be bridged by a falling tree, while even the main channels along the south shore of Campbell offer points only seventy-five or a hundred yards in width and very shallow. Over these the spread, since spread beyond question has taken place, is to be expected to have been relatively rapid, until the barriers of Milbanke and Hakai were reached.

Toward the mainland, though Fisher Channel is broad, stormy, and rough, the more northern water barriers are fairly narrow and quiet--less formidable than Hakai. If the extraordinary burst of new mutation-pressure originated on Hunter Mountain and spread over the island group, it is to be expected that the adjacent mainland shores, especially those north of Deane Channel, should be the first outside the group to receive the strain. Such insular development of the tendency seems most probable, but like all historical theories of distribution, claims no better foundation than likelihood.

Mainland origin is possible. Suppose, for example: (1) that these mutative tendencies were already present in some part of the mainland population, somewhat confined between Douglas Channel and Gardener Canal on the north and Smith, Rivers, and Seymour inlets on the south; (2) that their prevalence was held down to the present or some lesser frequency by the genetic inertia of the large, less-divided population; (3) that by a freak of luck their carriers were chosen to be ferried across the narrower northern channels to some island unit, after the elevation of the group, where they had time to attain their present very high frequency before being transmitted to the rest of the group. This is a cogent, though less simple, explanation. In favor of actual island origin, however, there are three arguments of some weight.

First, the fact that the same present island group includes another deeply-interwoven character, seemingly part and parcel of the tendencies to deep coloration, which *is* strictly endemic, and not shared with the mainland nor with Hecate,--the darkly saturate color of the body and back stripe, a splendid character which is as strong in the juvenals as in the adults. This, at least, since it exists nowhere else, must certainly have been indigenous to the island group and have had a history like the one first suggested. Therefore it is eminently probable that the same mechanism created the rest, since they so closely agree in distribution and in character. Second, as we have already suggested, because of the short time involved, the many barriers to be crossed, the superficiality and high variability and hence probable novelty of the characters, it seems much more probable that we are dealing with what was, and probably still is, the dynamic centre, the very crater, of an indigenous phenomenon, and not with some peripheral fraction or product of migration. Third, mainland origin or development somewhere on the island group after its elevation removes the element of high isolation from the proposed mechanism, or greatly weakens it. The islands of the Hunter-Bardswells have not possessed sufficient isolation to have differentiated materially any of their many individual populations. It seems therefore hardly probable that in the present state any one of them could have fostered so extraordinary an endemic phenomenon.

It might be supposed that the thinner seaward ice-lip, the more rapid submarine melting and calving, the lesser precipitation, and the greater distance from the main body of the ice-cap, and the high, cold altitudes would have caused the clearing of the islands earlier than the mainland. This, however, cannot be advanced with confidence as an argument for the insular origin of the race, because it is somewhat difficult to imagine the ancestral stock as reaching the islands except from the more or less adjacent mainland. Whether from the north or the south, island-to-island progress, even if we grant the possibility of the survival of interglacial populations on Vancouver Island during Vashon time, involves the passage of an enormous series of obstacles, compared to straight spread over a continuous mainland habitat. Yet it must be remembered that the actual clearing of the island ice may have been even slower than the animal's power to follow, and that the present adjacent mainland habitat is not continuous, but broken by a great number of deep inlets, reaching inland beyond the range of the pure headland form and probably, at the time of occupation, beyond the edge of the retreating ice edge which connected the fiord glaciers. Therefore the progress on the renascent mainland may well have been beset by barriers equivalent to those between the islands.

Actually, however, these discussions are somewhat idle. As an illustration of the establishment and spread of an extremely bold set of racial characters, the hypothesis of *ultimate* origin of the mutative complex is of relatively small importance. In any case the chief interest lies in the localization and intensification, the sudden high-frequency occurrence, and the appearance of a strong and complex racial mosaic as the result of narrow isolation, under natural conditions, certainly within a period of from five to ten thousand years and probably in a much shorter period.

So far we have discussed the matter in the customary loose taxonomist's language, as though the degree of morphological resemblance were a mere continuous expression of degree of kinship, without thought of the segregation of characters or the laws of their transmission. And this, indeed, is about as far as the problem can be carried pending much more complete field data and experimental enlightenment on the nature and behavior of the characters in question.

None the less, a few comments are possible on the broadest aspects of the apparent genetic complex.

(1) It is obvious that we have an essentially isolated population with many strong variations, each showing evidence of subdivisibility to such a degree as to give the appearance of continuous variation.

(2) The impression that these characters are the combined product of abundant sudden, local, and recent mutation is derived from their absence elsewhere, their startling abruptness and boldness, and of course from the biological youth of the whole region. It is almost unthinkable that an anciently derived strain, of complex and distant origin, could have migrated from somewhere beyond the ice-capped area and contrived to get itself marooned on so small and inaccessible a range without leaving a genetic trail over the course of its migration. Be it noticed that we speak throughout this discussion not of specific mutations but of the phenomenon of the *tendency to mutate*, in certain directions. The number of gross characters and their great and obvious respective complexity makes it quite impossible to deal individually with the characters or their subdivisions or factors except through immense amounts of material and elaborate experimentation. With such characters and such degree of subdivision not one nor several but a host of mutations must have been involved, and considering such complexity with the youth and vigor of the phenomenon, the mutation pressure is to be expected still to be high.

(3) Opposed to this pressure we must expect the contrary operation of the forces for the scattering and elimination of variability, the effect of "random sampling" and the processes of chance recently analyzed by Sewall Wright (1940) and others as agents of simplification of small populations. With such extremely small populations as many of those with which we have to deal it must be assumed that, barring very strong and continuous mutation pressure, a stable homogeneity would be attained very rapidly, yet the populations of the Hunter-Bardwells, while rather uniform as from island to island, are a welter of variability within themselves. The various categories we have adopted for the red bellies are of course mere groupings, subdivisible in innumerable degrees.

(4) As to the red and extremity characters, to what extent the prevalent phenotypic aspects, in a population which is so far from being homogeneous, may be aided by various degrees of partial dominance, it is impossible to guess. It may be worth notice in passing that the presence or absence of some manifestation of these characters, over the island group, shows a ratio vaguely in the order of magnitude which would obtain, under Hardy's Law, from free breeding without excessive muta-

tion or other interference from an ancestral pair or very small stock in which RR, FF, TT, and rr, ff, tt had been approximately equal. That is, there exists a phenotypic ratio somewhere in the general neighborhood of 3:1, or the square of RR + rr, and the other alleles in subequal proportions, with dominance. The existence of such a ratio, in a simpler instance, in a large population, might constitute a hint of the origin of the race from some group such as a single litter with more or less equal proportions of mutation and non-mutation. In a small population, however, the opposing forces of simplification might be expected to destroy such balance, and in any case the complexity of the present picture, with its obvious high mutation frequency, is to be expected to obliterate any such simple evidence.

(5) That the prevalent tone of the phenotypes and the high *local* degrees of correlation between red and extremity characters should involve agencies such as manifold or pleiotropic manifestations of single factors, or any form of linkage, seems unlikely. Examples of complete divorcement of almost any pair of characters or degrees of characters are very common, not only within individual populations but to a lesser extent between populations, as exemplified by the silver feet of Swindle Island, to take a single example.

(6) As to the saturation character, the situation appears somewhat different, which in some degree works against our use of it in the argument in favor of island origin. The true Hunter Islands appear to possess this in uniformity, with, to the limit of our sampling, one hundred per cent of phenotypes with maximum saturation. Campbell Island and the Bardswells may be somewhat less uniform. It may be that in these cases recessives have actually been eliminated, or nearly so, or that the variability has been scattered and eliminated. It is quite possible, on the other hand, that very large sampling may change the picture in some degree. Such a situation might reflect a different original ratio, with ss in great minority, a higher mutation or migration pressure in favor of SS, or a greater degree of dominance. On the other hand, if the recessives, or mere deficiency factors, are absent, or nearly so, it is not improbable that a force moving toward the scattering of variability, a highly complex operation of the "Sewall Wright Effect," has operated more decisively here than in the case of the red and extremity characters, perhaps because the saturation character depended on simpler, less multiple, more quickly disposable, factor-complexes.

(7) Any more elaborate effort to solve these problems must keep continuously in mind the youth of the population and the high probability that it represents no equilibrium or picture of finality, as the smaller single-island populations probably do. The great confusion is probably

to be interpreted as evidence of a state both of youth and active, unbalanced forces, both assimilative and mutative.

(8) The ever-present, ever-vague problem of the possible place of selective values, though it may not be discarded too thoughtlessly in the general consideration of the tendency to dark coloration throughout the regional vertebrate fauna, could hardly be suggested as influencing the preservation of mutations to such a degree as to be responsible for the *rubriventer* complex. Unquestionably the *forests* of the northwest coast are extremely dark, and light of as low an average intensity as is likely to be found on similar latitudes. But the forest is not the metropolis of *Peromyscus*, and it remains to be shown whether dark-colored feet and underparts would be of greater advantage to creatures living in strong light or in shadow.

It seems unquestionable that these mice are extraordinarily free from enemies, which may be a further reason for the success of such small populations. Screech owls and horned owls exist on the islands in such small numbers as to be of almost accidental occurrence, and they are very rare on the headlands. *Peromyscus* is not common horned owl prey in the north. Weasel are absent from the majority of the islands and far from abundant on the headlands. Peale falcon appear to live entirely on ocean birds, and smaller hawks are extremely rare and of course diurnal. So great is the evidence of the subsistence of the mink on crabs and other shell-fish, and so definitely does their behavior seem to be directed against such prey as we see them working alongshore, that we cannot believe that they levy a large toll on the mice.

What deeper, less naïve, adaptive advantages may accompany the variations in question it is as usual quite impossible to guess. The general attitude of genetically-minded naturalists toward such phenomena as we have described is well expressed in a single line by Wright (1940b): "While direct control [of the environment] over mutation is not in line with present knowledge of genetics, indirect control through differential selection seems probable enough. . . ." The *theory* of such control is well developed, but evidence of its actual existence is very rare. Fisher (1930), for example, has computed and tabulated the probabilities of extinction and survival, for various numbers of generations, of mutations conferring one per cent advantage, and shown how slight an increase of probability of survival such a degree of advantage represents. It seems sufficiently ridiculous to suggest that such a degree of advantage could result from the color variations of these particular organisms in their particular set of associations, or that, even granted a seemingly unlikely degree of advantage, the resulting increase in probability of survival could possibly have created so bold and so complex a pattern.

(9) The subzonate, concentric reduction in frequencies on the more remote islands, suggests various explanations. One of these is very recent transmission and slowness to spread. Considering, however, the speed of spread and mixture of such organisms, the fact that some of the outlying islands are small, and their number too great for them to be supposed to be uniformly in so fugitive a stage, this explanation is hardly of general application, though it may well suggest a contributing cause or account for single instances. A more probable cause might be found in the progressive differences in the constitution of the peripheral populations, as, with greater distances from the centre, these were and are more based upon immigration from elsewhere, less from the metropolitan area of the mutant population. A slightly different putting of the case,—viz., that with radial geographic displacement, with greater distance from what we have called the crater of the mutative tendency, the mutation pressure falls, even though unaffected by population exchange—actually involves a profoundly different point of view.

Very little wild vertebrate material has ever, at first glance, suggested the complexity of its genetic constitution better than the racial unit in question, or promised a more formidable and extensive task to whomsoever may undertake its genetic analysis by experimental methods. F. B. Sumner, for instance, with various co-workers, between 1917 and 1924 worked on racial crosses of *P. polionotus*. Both genetic segregation and increased variability in the F2 were demonstrated, but very narrowly, with long study and refined technique. It is almost appalling to consider what variegation and degree of spread the bellies, tail, and feet of *rubriventer* crossed with pure stock of *macrorhinus* from outside our area might be made to produce in the F2 and subsequent back-crosses.

2. *The Single-island and Small-group Races*

The present paper consists in a preliminary outline of the naturally-occurring situation, with hardly more attempt at analysis than is inherent in a somewhat two-dimensional viewpoint,—including, thanks to the geologists, something of the element of time with that of area. It is not, therefore, necessary to summarize in detail the genetical theories of isolation. Suffice it to say that, for small isolated populations, theories, both of the efficacy of mutation in creating differentiations from a parent stock, and of the efficacy of the laws of chance in scattering and eliminating variability, are well developed. As to natural exemplification of such theory, large numbers of forms, apparently the result of many degrees of isolation, have been described. But the great majority of these represent advanced degrees of differentiation, potentially the products of vast periods of time with many unknown environmental changes.

The opportunity to examine an extensive natural series of changes and reassortments in early, actively, almost visibly, formative stages, under conditions of almost laboratory-like confinement, stemming from minimum numbers of recent and rather definitely known immigrants, offers the possibility of drawing genetic theory and natural phenomena somewhat more closely together. Naturally, therefore, interest centres in the smallest populations.

It is a peculiar fact that, as just explained, the most striking product of small numbers and isolation has been produced, not by present, but by past conditions, and probably offers an example of the manner in which great populations may have their characters set by original or intermediate periods of small size and confinement. It is quite possible, since most of the groups about to be discussed occupy the less accessible areas, that their smaller average degree of differentiation may be to some extent the result of more recent or slower colonization instead of smaller mutation pressure. But the geology of the region does not show likelihood of differences in the ages of the islands as habitable environments nearly commensurate with the differences in degree of variation between *rubriventer* and other differentiated forms.

The following general observations apply to the smaller groups.

(1) All the islands or isolated groups which have produced endemic races (with the exception of the present range of *rubriventer*) are small. No large island, even with the isolation of, for example, Aristazabal, has produced a distinct race.

(2) Conversely, all the small islands *with distant separation* are represented by distinct races (Goose, Moore, Table, probably the ill-represented Pine).

(3) The small islands and small groups with endemic races which are not widely isolated by distance (Balaclava, the Duncan-Hurst-Heard-Bell group, and Doyle) are separated by very short, wind- and tide-swept, turbulent, and usually deep "guts" with great exposure. However narrow, drift from one shore would be unlikely to reach the other without being carried to sea and returning, and being subjected, either in the gut itself or in the course of the voyage, to rough water. Nothing could be less like the quiet inside channels of the Hunters and Bardswells. It must be admitted that Doyle is cut off by a very narrow channel, but one which is a fierce wind-tunnel, with every character of the roughest "outside" conditions.

(4) Of all the islands known to us which might be included in the type described in (3) at least 75 per cent bear endemic races or are included in small-group races.

(5) Certainly if jumbled sets of unrelated and inconsistent differ-

entiae are indicative of random mutative origin, neither induced nor selected by common factors of physical surroundings, scrutiny of the races in question might shadow forth such a creative mechanism, for the following reasons. The only exception to this is the general shorter tail and skull dimensions of island as opposed to mainland populations.

(A) Size. Since the curiously spotty and inconsistent manifestations of small size in the Gordon-Goletas groups are reasonably to be attributed to the close consanguinity of the northern Vancouver Island population, Table Island, with its position almost in the mouth of Smith Sound, is our only illustration of evidently indigenous insular dwarfism, of which so many examples have been published (Hesse, Allee and Schmidt, 1937, 523-524). Yet Pine Island, its closest analogue in locality, minute size, environment, and exposure, bears a little-known race which is probably gigantic in body size and certainly not below average. Gigantism in mild degree, without hint of explanation from consanguinity, has undoubtedly arisen on the Moores, yet the very analogous Goose shows average dimensions.

(B) Color. Of the small isolated islands all but one show size differentiae, while only one, Table, is extraordinary in color. Yet the greatest and most variegated of all color variants, *rubriventer*, is taken to be the result of small numbers and isolation in the past, and the instances are in any event too small to suggest the generality that size is more apt to mutate under such conditions than color.

3. *Insular Variation and the Regional Fauna*

There is a generality amounting to a law that when endemic variation occurs on the northwest coast,—and subspecific variation is extremely common—the races differ from those of the interior in the direction of deeper melanotic coloration. Now if the peculiar environment possessed some power to stimulate or to select mutation in these directions, then small and isolated fractional populations, more particularly when subjected to high degrees of that exposure which is as characteristic of the outer coast as it is, elsewhere, of Hudsonian or Alpine timberlines, might well be expected to act as natural experiments under intensified conditions, and to show a certain direction of variability. This, in the deepest sense, was the chief incentive for the present investigation. If in a wealth of small and isolated population-units there might appear any uniformity or correlation of variation with physical conditions or with the great regional tendency as expressed in the whole vertebrate fauna, then, while the basic motive power might remain as mysterious as before, the superficial mechanism might in some degree be indicated.

According to the concensus of the island races, taken, so to speak, vote by vote, with votes of equal weight, such a hope has been disappointed. There is no unanimity, quantitative or qualitative. Tendencies precisely contrary to the regional rule are not absent. The case of Table Island, one of the most extreme examples of differentiation, small area, and exposure, is, with its very light color, an outstanding example of reversed variation.

Yet we are strongly inclined to believe that the votes should not be counted as of equal value, but that, on the contrary, the single voice of the extraordinary phenomenon we have called the race *rubriventer* is far more significant than all the rest put together. This is an almost explosive release of the precise energies which in all sorts of pelages and plumages have had their effect on the regional fauna. A variety of shades and hues of presumably melanin-based color, from neutral gray or gray-brown to what is probably as pure a red as occurs in the *Mammalia*, have appeared not only over a variety of unpigmented body-areas but in the intensification of areas already colored. These represent an outburst of transforming energy such as can hardly be said to occur elsewhere in *Peromyscus*,– certainly not as to the complexity and variety of the result. It has furthermore appeared in such complete geographic isolation that it might have sprung from the local earth.

It may be urged, as against the significance of this phenomenon, that it does not necessarily indicate peculiar vigor and viability, but merely a peculiar original strategic position with a fortunate subsequent geologic sequence.

In point of fact, however, it is perfectly evident that neither small size, degree of isolation, greater potential age, or final opportunities for distribution can be relied upon to produce this or any analogous condition, but that the race, however favored in its history, must be looked upon as primarily the product of an extraordinary manifestation of energy, which summarizes within itself the whole expression of the endemic fauna of birds and mammals. That is, at least one out of what is after all only a handful of well-framed natural experiments in small size and isolation has reacted with explosive violence.

While Hunter Mountain or any other early point of isolated sojourn was small, it was no smaller than many other islands which have produced relatively simple races or failed to produce distinguishable variation. All the rest represent, roughly, subspecific variation at its minimum demonstrable stage,– with one or two characters substantially perceptible, but no more, presumably the mere products of the action of chance on relatively insignificant individual variation. *Rubriventer* shows some four classes of characters, all or most genetically separable and indefinitely subdivisible.

That such a phenomenon, of such direction and with such power of spread, should occur at such a point, is too significant to be ignored in the consideration of the character of the fauna as a whole. It may probably be thought of as a revelation of certain deep-seated energies, somehow connected with the peculiar environment, acting slowly on the great populations of the region as a whole, but here breaking forth, under peculiarly favorable conditions, in a volcanic manner.

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SUMMARY

SECTION 1. Age and evolution of the habitat:—the geological background.

The present state of geological knowledge and opinion as to the character and degree of antiquity of the last ice-cap glaciation of the region west of the Rocky Mountains is reviewed, and shows overwhelming evidence of conditions, not more than a few thousand years past, which must have rendered the area about to be treated uninhabitable to all but rare and highly-adapted land-vertebrates. The facts as to correlative recent elevation of the coast are hardly less important to the zoological history of the islands and headlands, and are included in this review.

SECTION 2. Topography, climate, and flora. The salt-water barriers.

The peculiarities of the insular topography and littoral oceanography and the (to *Peromyscus*) unfavorable climate are discussed, as well as the flora, its probable history, and the further light thrown by it on the age of the habitats and the character of the local distribution. The colonization of the islands with small terrestrial vertebrates by means of "slide-rafts," perhaps with human co-operation during the old Indian civilization, is discussed at length and considered highly probable.

SECTION 3. The faunal environment.

Our own collections include some 1391 small mammals, 1216 insular, 175 mainland-headlands. 993 of these are *Peromyscus*, to which the field work was primarily devoted. Other material was incidental, but forms the basis of a discussion of the mammalian faunal environment. We also had 202 specimens of *Peromyscus*, *Clethrionomys*, and *Microtus* by loan from museums and collectors. Our own collecting activities covered some 38 islands and 4 mainland stations. Borrowed material added 2 more islands and 5 mainland sites.

SECTION 4. Peromyscus.

Treatment of *Peromyscus* opens with discussion of the associations and abundance, and with the approximate sizes of the insular populations, from those quite certainly of less than a hundred individuals to those of great size. One or two small islands were found to be uninhabited by the species. The instances of small population-number are of the utmost importance in the light of genetic theory and the actual status of insular endemism.

The methods of handling the quantitative and qualitative characters are discussed, a category of color phases with representative islands is drawn up, and somewhat arbitrary groupings are adopted for the various degrees of red belly, dark or silver feet or tail, and several cranial characters.

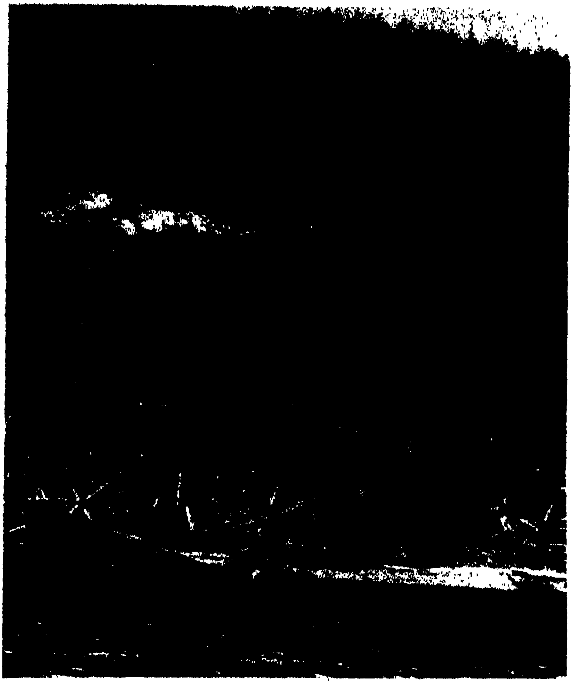
A section is devoted to the correlations of the several striking color mutations just mentioned. Rather high correlations, both as to presence and degree of the several elements is demonstrated, but never perfect correlation or inseparability. Some degree of manifestation of all the character groups exist in isolation on one or more islands.

The mainland coast from Lowe Inlet to Rivers Inlet is found to be essentially uniform and in agreement with six topotypes of *Macrorhinus*. Inlet-head populations, on the other hand, are smaller throughout. Two interpretations are suggested. (1) That *macrorhinus* extends southward through the area along the *outer* coast, while *oreas*, which, from the south, reaches Loughborough Inlet at least in pure form, extends its influence northward on the "inside," creating more or less of an overlap. (2) That the character of the inlet-head populations is due to consanguinity with the *artemisiae* of the interior, with which the inlet valleys are connected by relatively low passes. The Kingcome Inlet series undoubtedly illustrates intergradation between *macrorhinus* and *oreas*.

Within our insular area proper, between Dixon entrance and Queen Charlotte's straits, two main groupings are evident. One centres about the Bardswell and Hunter archipelagoes and is an extraordinary example of bold and diverse mutation and variation. The other constitutes the remaining islands, with numerous simpler insular variations of racial or sub-racial value, closer to the mean of the mainland *macrorhinus*. The characters of the individual island populations are reviewed at length. The variegated character of the populations of the Goletas and Gordon groups, just off northern Vancouver Island, seem to reflect confusedly the characters of the several races which surround or approach the area,—*macrorhinus*, *oreas*, *isolatus*, and *austerus*. "Only the unique cranial characters of the Doyle Island mice are not represented in some combination within ninety miles of these islands." Seven island races are described and named.

SECTION 5. The meaning of the geographic pattern.

An effort is made to explain the present taxonomic picture through the geological and climatic history, and to shadow forth in some degree the nature of the genetic mechanism involved. The nature of biological insularity is considered in the light of genetic theory, and an historical hypothesis, based on the recent complete submergence of the Bardswell and Hunter groups, but for the persistence of a single high point, is proposed. For the other populations the high correlation of differentiation with smallness of population-number and degree of isolation is analyzed. The absence of uniformity in the modes of the minor racial and sub-racial variations is pointed out, but the fact is emphasized that the outstanding phenomenon of the area, the occurrence of the *rubriventer* complex, overshadowing all other variants in intensity, multiplicity of characters, and evident ability to spread, may be looked upon as a volcanic manifestation, under conditions of small-size, isolation, and exposure, of those tendencies which the coastal land-vertebrate populations as a whole exhibit in a high degree of uniformity.



A. Port Alexander, Nigei Island, June 11, 1939. The slide had run late the previous autumn.

B. *P. m. rubriventer* subsp. nov. (Townsend Id.) St. John's Harbor, Bardswell Islands, August 25, 1938. The phases Leg-spot (rather weak) and Stripe.

McCABE & COWAN: *PEROMYSCUS MANICULATUS MACRORHINUS* AND THE PROBLEM OF INSULARITY

A BOTANICAL SURVEY OF WATERLOO COUNTY, ONTARIO[1]

F. H. MONTGOMERY

Areas surrounding large urban centres are generally over-botanized, while the flora of rural territories is left to "waste its sweetness on the desert air," or to the professional botanist who may have some particular axe to grind in surveying any definite region. In the case of that part of Ontario between Hamilton and the Bruce Peninsula, it has been neglected even by the botanists. Only one extensive collection, made by William Herriot in the vicinity of Galt, some fifty years ago, is known from this large and botanically interesting area. With this in mind I decided a few years ago to make a floral survey of the entire county of Waterloo.

As the survey progressed, it became evident that many plants, representative of the Carolinian or Interlacustrine Zone, extended northward into the county, and intermingled with the floral elements of the Eastern or Alleghenian Zone. No previous attempt had been made to determine the numbers of these intrusions or the distance that they extended northward. In this paper, therefore, plants considered by various authorities as belonging to the Carolinian flora, and their known northern limits, have been indicated, and a possible area of demarkation between the two above mentioned zones has been suggested.

The area discussed lies approximately half-way between Lake Huron and Lake Ontario, and is slightly south of half-way between Georgian Bay and Lake Erie. Its most easterly and westerly boundaries are between 80° 14′ and 80° 53′ west longitude, and its north and south boundary limits are between 43° 16′ and 43° 41′ north latitude.

It covers an area of 516 square miles, with an acreage of approximately 302,829 acres. Of this 241,575 acres are improved and devoted to crops, and 61,254 acres are unimproved. Of the latter 10.6 per cent or 32,228 acres are woodland, and 8,648 acres are waste land.(13).

Waterloo county lies in the St. Lawrence Region of the physiographic regions of Canada (4). The underlying rocks are chiefly limestone of the Silurian and Devonian Systems, and these are covered, except for a few outcroppings along the Speed and Grand Rivers, by thick deposits of glacial debris. This glacial material is so distributed as to produce a topography which is described by Caley (1941) as "gently undulating with low relief."

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[1] The notes presented here are a summary of a thesis presented as partial requirements for the degree of Master of Arts at McMaster University, May, 1944.

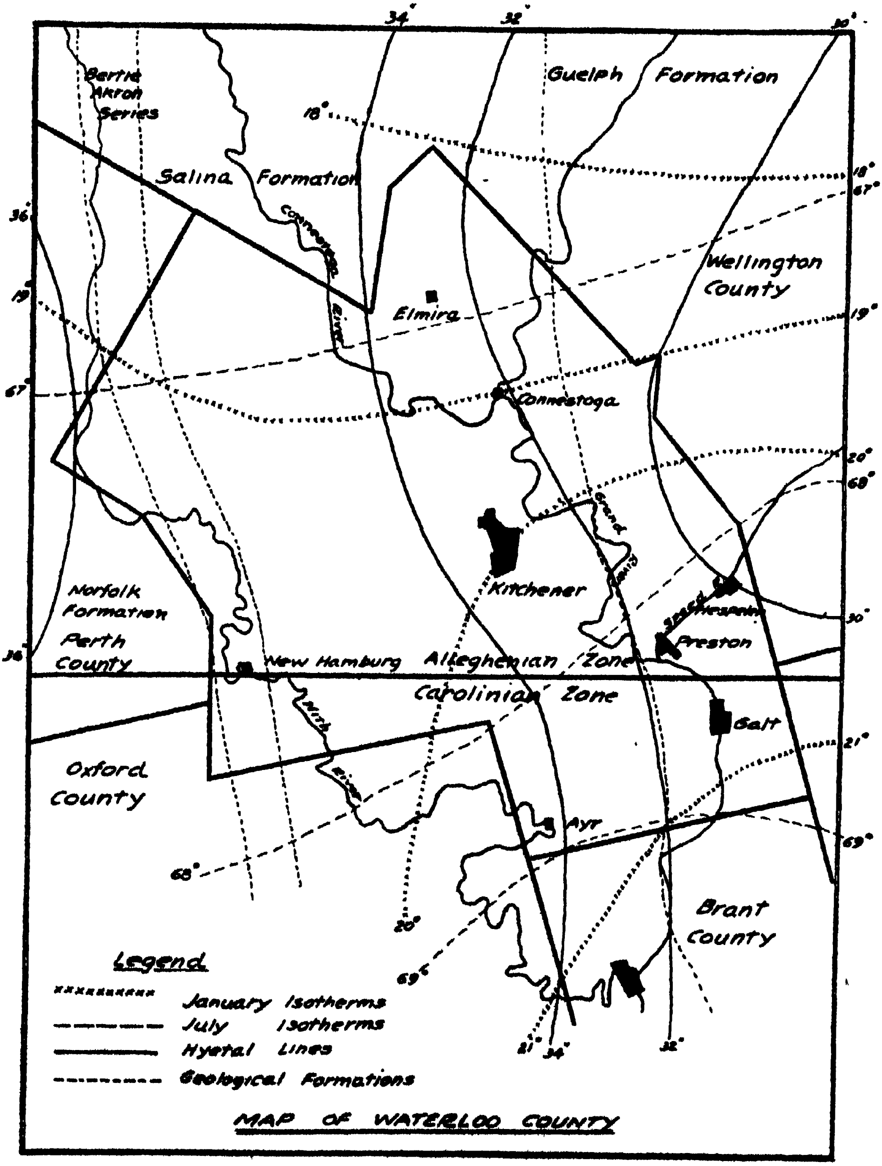
The county is drained into Lake Erie by way of the Grand River system, which consists of the Grand with its tributaries, the Conestoga, Nith, and Speed. The Grand River flows from north to south almost the entire length of the county, and its winding course is indicative of its relatively small gradient, averaging 12 feet per mile. The Conestoga River with its many little tributary creeks, drains the more northerly part of the area, and, joins the Grand River near the village of Conestoga. The Speed River enters from Wellington county near the town of Hespeler, and, flowing westward, empties into the Grand River near Preston. Along almost the entire western border of the county passes the Nith River. All of these rivers overflow their banks in the spring, and the water may cover considerable areas, forming rich bottom lands.

Throughout this county are many small glacial lakes, among which are found all stages of a hydrosere. Visitors to these little lakes see areas of deep open water followed by the submerged, floating, reed-swamp, sedge-meadow, woodland and climax forest stages.

A survey of the soils of the county shows the main groups and the percentages of the total area covered by each, as follows: Loam, 49.2%; sandy loam, 23.6%; clay loam, 16.5%; bottom land, which is that land of the river-flats subject to the overflow of the rivers during flood times, 6.4%; muck, including areas of bog and succeeding swamp stages, and which remain more or less damp all the year, 3.9%; and sand 0.33% (31).

The direct effect of the soils on the distribution of plants has not been thoroughly studied, and much more collecting over wide areas would be necessary in order to reach definite conclusions. However, some general ideas can be given from the work that has been done. No particular difference in the floristic content, due to soils, appears to occur between the three loam groups. There are, however, some species found in the bottom land group that have not been seen elsewhere. Among these are: *Erythronium albidum*, *Celtis occidentalis*, *Jeffersonia diphylla*, *Menispermum canadense*, *Platanus occidentalis*, *Staphylea trifolia*, *Acer nigrum* and *Erigenia bulbosa*.

Bog areas surrounding the glacial lakes, because of their acid nature, have a flora quite limited to those areas only, and composed largely of ericaceous plants, orchids, grasses, sedges, sun-dew, pitcher-plants, and tamarack. Muck areas, including sedge-meadow and woodland stages, have species such as *Typha latifolia*, *Dryopteris Thelypteris* var. *pubescens*, *Osmunda cinnamomea*, *Thuja occidentalis*, species of *Carex*, *Arisaema triphyllum*, *Smilacina stellata*, *Salix* species, *Caltha palustris*, *Coptis groenlandica*, *Cardamine* species, *Mitella nuda*, *Impatiens biflora*, *Hydrocotyle*



MAP OF WATERLOO COUNTY

americana, *Cornus stolonifera*, *Gaultheria procumbens*, *Chiogenes hispidula*, *Trientalis borealis*, *Scutellaria lateriflora*, *Lycopus uniflorus*, *L. americanus*, *Linnaea borealis* var. *americana*, and *Bidens* species.

Between Preston and Galt, where outcroppings of the Guelph formation occur, there have been found species that frequent rocks of a limestone nature, such as, *Pellaea glabella* and *Asplenium Trichomanes*. *Polypodium virginianum*, which was also found here by Herriot, is believed to be extinct.

Temperature tables (30) covering a period of 34 years show that the mean monthly temperatures for the year at the city of Kitchener, which is about the centre of the area discussed, are as follows:

MEAN MONTHLY TEMPERATURES FOR KITCHENER

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
21.2	20 6	29.8	41.8	54.1	63 9	69.2	66 8	60.0	48 0	36 0	24.8	44.68

Chapman (1938) showed that the mean July isotherm for the northern part of the county is 67° F., and for the southern part, it is about 69° F. In January the north has a mean of 19° F., while the south has a mean of 21° F. The lowest recorded temperature for Kitchener is -29° F., while the highest recorded temperature is 101° F. The average number of days between the last killing frost in the spring and the first frost in the fall is 133 days in the vicinity of Kitchener.

The extreme western part of the county has a precipitation of 36 inches per year, while the extreme eastern portion receives 30 inches of moisture. The total monthly precipitation for Kitchener as recorded for 23 years is:

TOTAL MONTHLY PRECIPITATION FOR KITCHENER

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
2.73	2 14	2.15	2.56	2.74	2.80	3.02	2.39	2.94	2.42	2.72	2.58	31.19

Guelph is the only station in this vicinity that has recorded the total duration of bright sunshine, and, since it is in Wellington county, and only 4 miles from the eastern limits of Waterloo county, it is included here as an indicator of the sunshine hours in our county. These records cover a period of 44 years.

NUMBERS OF HOURS OF BRIGHT SUNSHINE IN GUELPH
AND PERCENTAGE OF THE POSSIBLE

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Normal hours	65	87	129	152	219	252	276	240	173	184	76	50
Percentage of Possible....	22	30	35	38	48	55	60	56	46	39	26	18

FLORAL AFFINITIES OF WATERLOO COUNTY AND VICINITY

Merriam (1898) divided the United States and the southern part of Canada into seven "Life Zones and Crop Zones." The southern peninsula of Ontario was included as a part of the Transition Zone and the Upper Austral Zone. That part of the peninsula north of a line drawn from the eastern end of Lake Ontario to Windsor, was included in the Alleghenian Area of the Transition Zone, and the part south of this line was considered as part of the Carolinian Area of the subdivisions of the Upper Austral Zone.

Macoun and Malte (1915) included the Alleghenian Area in their Hardwood Forest Zone, but their Carolinian Zone corresponded to that of Merriam. Neither Merriam nor Macoun and Malte included any part of Waterloo county in the Carolinian Zone.

More recently, Adams (1938), defined the limit of the Carolinian or Interlacustrine Zone so that it included that part of Ontario south of a line from the north shore of Lake Ontario to Sarnia, thereby including the portion of Waterloo county south of Galt in this zone.

In Halliday's classification of the forest regions of Canada (1937), the Deciduous Forest Region is comparable to the Carolinian Zone of the other writers, but extends even further northward along the shore of Lake Huron to the vicinity of Grand Bend. However, it does not include any part of Waterloo county.

For an intensive study of a flora somewhat closely allied to the region under discussion, there is to be found in Wiegand and Eames (1925) a listing of the flora of the Cayuga Lake Basin. According to Merriam (1898) this would be in the Alleghenian Area of the Transition Zone, and this is substantiated by Wiegand and Eames (p. 453), who state that the flora of the Cayuga Lake Basin is "strongly Alleghenian." These writers also refer to a distinctly southern element including 79 species, and to a strongly marked western and southwestern element of 73 species that have become established in the area they discuss. In this present work, the catalogue of Wiegand and Eames has been extensively used in discussing species considered as belonging to a more southern and western flora, which appears also in the flora of Waterloo county.

Zenkert (1934, pp. 46-48), in considering the zonal relations of the Niagara Frontier Region, describes the flora of that area as also having in the main "features of the Alleghenian Area of the Transition Zone, with a distinctly defined flora of the Carolinian Area of the Upper Austral Zone." A study of the Niagara flora shows that at least 116 southern species, and, 36 western and southwestern species are to be found there. These western and southwestern plants are chiefly representatives of the flora of the Ohio and Mississippi Valleys.

Considering the flora of the Hamilton area as recorded by Dr. and Mrs. Craigie (1853-1854), Logie (1861), Buchan (1874), and the collection of the Hamilton Association (housed at McMaster University), it is found, that in addition to its distinctly Alleghenian flora, there have been 72 southern and 6 western and southwestern species collected. There is also a number of representatives of the Transcontinental Region of Adams (1938), extending into this area.

In Waterloo county we have many species belonging to the Transcontinental Zone of Adams, and some of the characteristic species found here are: *Larix laricina*, *Abies balsamea*, *Potamogeton natans*, *Triglochin palustris*, *Eriophorum angustifolium*, *Deschampsia caespitosa*, *Hierochloe odorata*, *Corallorrhiza trifida*, *Populus tremuloides*, *P. balsamifera*, *Betula papyrifera*, *B. glandulosa*, *Stellaria borealis*, *Coptis groenlandica*, *Ribes triste*, *R. oxycanthoides*, *Potentilla fruticosa*, *Viola renifolia*, *Shepherdia canadensis*, *Moneses uniflora*, *Kalmia polifolia*, *Ledum groenlandicum*, *Andromeda polifolia*, *Chamaedaphne calyculata*, *Arctostaphlos Uva-ursi* var. *coactilis*, *Chiogenes hispidula*, *Melampyrum lineare*, and *Linnaea borealis* var. *americana*.

There is also a definitely marked Alleghenian flora (sensu Merriam), of which the following may be considered as representative: *Taxus canadensis*, *Pinus Strobus*, *Tsuga canadensis*, *Trillium grandiflorum*, *Polygonatum biflorum*, *Juglans cinerea*, *Carya cordiformis*, *Betula lutea*, *Fagus grandifolia*, *Quercus macrocarpa*, *Q. borealis* var. *maxima*, *Ulmus americana*, *Claytonia virginica*, *Clematis virginiana*, *Actaea rubra*, *Sanguinaria canadensis*, *Dicentra canadensis*, *D. Cucullaria*, *Dentaria diphylla*, *Tiarella cordifolia*, *Ribes Cynosbati*, *Hamamelis virginiana*, *Spiraea tomentosa*, *Waldsteinia fragarioides*, *Rubus odoratus*, *Prunus serotina*, *Zanthoxylum americanum*, *Rhus typhina*, *Ilex verticillata*, *Nemopanthus mucronata*, *Acer saccharum*, *A. rubrum*, *Vitis vulpina*, *Tilia americana*, *Dirca palustris*, *Circaea latifolia*, *Aralia nudicaulis*, *Osmorrhiza Claytoni*, *Fraxinus americanus*, *F. nigra*, *Gentiana Andrewsii*, *Chelone glabra*, *Solidago latifolia* and *Aster cordifolius*.

An analysis of collected species also shows that there is a considerable Carolinian element present in the county. Sixty-four species which have been designated by Merriam (1898), Macoun and Malte (1915), Adams (1938), Halliday (1937), Wiegand and Eames (1925), Zenkert (1934), as belonging to more southern areas have been recorded here, and the following list is a tabulation of these. The approximate northern range of these species, as it is known here at present, is also indicated. *Muhlenbergia tenuiflora*, Galt; *Cyperus erythrorhizos*, Galt; *Fimbristylis*

autumnalis, Galt; *Scleria verticillata*, Galt, also Bruce Pen. Krotkov (1940); *Carex retroflexa*, Galt; *C. Muhlenbergii*, Galt, also Bruce Pen. Krotkov (1940); *C. digitalis*, Galt; *Lilium philadelphicum* var. *andinum*, Galt, also Bruce Pen. Krotkov (1940); *Erythronium albidum*, Wallenstein; *Smilax hispida*, Kitchener, also Bruce Pen. Krotkov (1940); *Dioscorea villosa* f. *glabrifolia*, Galt; *Saururus cernuus*, Bridgeport, also Clinton, Huron county (1900); *Juglans nigra*, Galt; *Carya ovata*, Galt; *C. glabra*, Galt; *Betula lenta*, Waterloo; *Castanea dentata*, Galt; *Quercus Muhlenbergii*, Galt; *Q. prinoides*, Galt; *Q. coccinea*, Galt; *Q. velutina*, Galt; *Celtis occidentalis*, Conestoga; *Silene stellata* var. *scabrella*, Galt; *Anemonella thalictroides*, Galt; *Cimicifuga racemosa*, Galt; *Podophyllum peltatum*, Wallenstein; *Sassafras albidum*, Branchton; *Lindera benzoin*, Kitchener; *Platanus occidentalis*, Galt; *Malus coronaria*, Galt; *Agrimonia pubescens*, Galt; *Lupinus perennis*, Galt; *Desmodium bracteosum*, Galt; *D. marilandicum*, Galt; *D. rotundifolium*, Galt; *D. Dillenii*, Galt; *D. paniculatum*, Galt; *Lespedeza intermedia*, Galt; *L. violacea*, Galt; *L. capitata*, Galt; *Vicia caroliniana*, Galt; *Euphorbia corollata*, Galt; *Rhus vernix*, Galt; *Ceanothus americanus*, German Mills; *Sanicula canadensis*, Preston; *Erigenia bulbosa*, Wallenstein; *Gentiana quinquefolia*, Galt; *Asclepias tuberosa*, Galt; *A. phytolaccoides*, German Mills; *Hydrophyllum canadense*, West Montrose; *Monarda didyma*, German Mills; *M. fistulosa* var. *mollis*, Kitchener; *Physalis pruinosa*, Kitchener; *P. subglabrata* Galt; *Aureolaria virginica*, Galt; *A. flava* var. *typica*, Galt; *Gerardia tenuifolia*, Galt; *Conopholis americana*, Preston; *Triosteum perfoliatum*, Wallenstein; *Lobelia siphilitica*, Kitchener; *Erigeron pulchellus*, Galt; *Antennaria fallax*, Galt; *Helianthus divaricatus*, Galt, and *H. decapetalus*, Galt.

In addition there are 31 species that have their origin in the Ohio and Mississippi Valleys and farther westward. These are: *Carex Jamesii*, *C. Hitchcockiana*, *Arisaema Dracontium*, *Salix amygdaloides*, *Jeffersonia diphylla*, *Amelanchier alnifolia*, *A. humilis*, *Rosa Woodsii*, *R. setigera*, *Gleditsia triacanthos*, *Astragalus canadensis*, *A. neglectus*, *Glycyrrhiza lepidota*, *Floerkea proserpinacoides*, *Evonymus atropurpureus*, *Acer saccharinum*, *A. nigrum*, *A. negundo* var. *violaceum*, *Hypericum Ascyron*, *Myriophyllum heterophyllum*, *Verbena stricta*, *Lithospermum latifolium*, *Onosmodium hispidissimum*, *Agastache nepetoides*, *Campanula americana*, *Grindelia squarrosa*, *Solidago ohioensis*, *Gaillardia aristata*, *Helianthus tuberosa*, *Artemisia biennis*, and *A. gnaphalodes*.

Such a list of plants as has been given above confirms the fact that Adams' (1938) more northern limit for the Carolinian Zone has a good basis, and, that at least the portion of Waterloo county below Galt might be included in this zone. The fact that some species, for example, *Celtis occidentalis*, *Platanus occidentalis*, *Erythronium albidum*, *Jeffersonia diphylla*, *Erigenia bulbosa*, and *Hydrophyllum canadense*, extend well northward along the river-valleys, seems also to indicate that these valleys may have formed the highways for the advance of the southern species.

Stroud (1941), however, reports only 23 Carolinian species and 17 western and south-western species for Wellington county. This seems a rather small number in comparison with those in Waterloo county, since both are in the same latitude and of similar soil structure and ecological conditions. However, the main elements of the flora of Wellington county are the same as those in Waterloo county.

Tracing the northward distribution of the southern flora, it is found that records by J. A. Morton, at Wingham, and by A. Cosens, at Clinton, both in Huron county, show that the following 23 southern species were found in Huron county: *Lilium philadelphicum; Smilax hispida; Saururus cernuus; Carya ovata; Quercus prinoides; Celtis occidentalis; Nymphaea tuberosa; Hydrastis canadensis; Podophyllum peltatum; Lindera benzoin; Lupinus perennis; Lespedeza hirta; L. frutescens; Ceanothus americanus; Asclepias phytolaccoides; Acerates viridiflora; Hydrophyllum canadense; Monarda didyma; M. fistulosa; Triosteum perfoliatum; Lobelia siphilitica; Helianthus decapetalus*, and *Cacalia tuberosa*. There have also been found 14 representatives of the western and southwestern floras, and these are: *Arisaema Dracontium, Jeffersonia diphylla, Astragalus neglectus, Floerkea proserpinacoides, Acer saccharinum, A. negundo, Hypericum Ascyron, Myriophyllum heterophyllum, Lithospermum latifolium, Onosmodium hispidissimum, Agastache nepetoides, Monarda clinopodium, Helianthus helianthioides*, and *Artemisia biennis*.

The numbers of southern and of western and southwestern species are still further reduced in the Bruce Peninsula as indicated by Krotkov (1940). Here only the following 11 southern species are recorded: *Panicum flexile; P. virgatum; Carex Muhlenbergii; Scleria verticillata; Lilium philadelphicum; Smilax hispida; Castalia tuberosa; Ceanothus ovatus; Asclepias tuberosa; Monarda fistulosa* and *Cacalia tuberosa*. Krotkov also shows the following of western and southwestern occurrence; *Amelanchier humilis; Astragalus canadensis; A. neglectus; Acer negundo; A. saccharinum; Myriophyllum heterophyllum; Solidago ohioensis* and *Artemisia biennis*.

From these records it can be concluded that the number of southern, western and southwestern species rapidly decreases as one proceeds northward from the Galt area of Waterloo county.

SUMMARY OF STUDIES

Region	Author and Date	Number of Southern	Number of Western and South-western
Cayuga Lake Basin	Wiegand & Eames, 1925	79	73
Niagara Frontier Region	Zenkert, 1934	116	36
Hamilton Area	Craigies, Logie, Buchan, Hamilton Association, 1853-1896	72	6
Waterloo County	Montgomery, 1944	64	31
Wellington County	Stroud, 1940	23	17
Huron County	Morton & Cosens, 1890-1900	23	14
Bruce Peninsula	Krotkov, 1940	11	8

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INTERESTING COLLECTING AREAS IN THE COUNTY

The following notes are intended to give brief descriptions of certain localities that have been very productive of interesting species and in some cases numerous specimens. Wherever they are collecting areas that were also visited by Herriot, it has been the aim to indicate something of their former characteristics.

Altrieve Lake is about two miles west of Galt and consists of two or three acres of shallow water, surrounded by sphagnum bog and tamarack swamp. On higher ground, around the lake, is climax forest, and this whole area is one of the finest collecting regions in the county. Except for a reduction in the wooded areas, it is much the same as when Herriot collected.

Carrick's flats is now called Grand River Park, and has been turned into a tourist camp, and the surrounding area is used for grazing. However, the right-of-way of the Grand River Railroad, and the wooded slopes of the Grand River are still of interest.

Cressman's woods is about one and one-half miles south of Kitchener along the Grand River, and is for the most part dry woods with a small swampy area along the southern edge. The high banks of the river are moist and well wooded and good botanizing ground.

Dickson's woods was one of Herriot's collecting areas, and in his time was densely wooded. To-day it is Victoria Park in the city of Galt and therefore its importance as a source of interesting species is much reduced.

The First Island is one of a number of little islands in the Grand River below Galt. It was formerly wooded, but most of the trees there now are second growth, and it is being grazed by cattle. This and other islands are usually covered with water during the spring freshets.

The footbridge and the surrounding woods which were the locations of many of Herriot's records, have undergone considerable change. The footbridge was a wooden structure over the Grand River about a mile and one-half below Galt, and it was swept away a number of years ago in one of the annual spring floods, but it was replaced by a steel structure a little north of the original bridge. The woods of the river-flats have been for the most part cut down, and any that are left are over-run by cattle. The high wooded slopes of the river have also suffered from the woodsman's axe, and indirectly, so has the interesting flora of that area.

Hogg's swamp was a wet cold woods along the Grand River just south of Galt. It is now the site of a factory and the garbage dump for Galt, and none of the original woods remains unmolested.

The Nith River flats south of Haysville have some interesting features, for here we find *Arisaema Dracontium* and *Jeffersonia diphylla* in some profusion. *Trillium cernuum* var. *macranthum* has also been found, and the whole area is worth more investigation.

Orr's Lake is about one-half mile south of Altrieve Lake and was originally connected with the latter. An area of dense swampy woods now separates the two ponds. The lake is surrounded by a cranberry bog and many other ericaceous plants are common. *Rhamnus frangula* is also frequent around the lake.

Paradise Lake in the northern part of the county is mostly open water except at the eastern end, which is very shallow and produces an abundance of *Potamogeton* species, *Brasenia Schreberi*, *Nymphaea odorata*, *Nuphar advena* and *Utricularia macrorhiza*. The adjoining woods are chiefly climax, with some low cold woods. Nearby is also a large sphagnum bog with many ericaceous plants, *Picea mariana*, *Cypripedium reginae*, *C. parviflorum* and other members of the *Orchidaceae*, *Sarracenia purpurea*, *Drosera rotundifolia*, *Larix laricina*, species of *Salix*, *Aronia prunifolia* and others.

The rifle-range was about a mile north of Galt along the Grand River in the area of the limestone cliffs between Galt and Preston. There is only one woods now and it consists chiefly of small iron-wood trees, *Ostrya virginiana*.

Along the St. George road, which runs south from Galt to the village of St. George, are several small glacial lakes. These are no longer surrounded by the dense woods of former years, and one does not find to-day the number of species that were present in the earlier part of the century.

Sunfish Lake is northwest of Kitchener and is similar in many ways to Paradise Lake, but it has a greater area of cold, damp woods.

Wrigley's Corners is about five miles southwest of Galt. There is a group of glacial ponds in the vicinity and some of these are very shallow and are almost dry in the late summer. Practically no woods remain in the proximity of the lakes.

LIST OF VASCULAR PLANTS

The sequence of families and genera is in accordance with that of de Dalle Torre and Harms (1907), except in the families *Polypodiaceae* and *Gramineae*. In the *Polypodiaceae* Christensen's (1938) classification has been followed, and the arrangement of Hitchcock (1935) has been used in the *Gramineae*. Botanical names are in accordance with the International Rules of Botanical Nomenclature, and Gray's New Manual of Botany (1907) has been followed in this regard. Where there is known to have been nomenclatural revision, the more recent name is used, and, if known, the reference to the literature where the change has been discussed is given, while the name in Gray's Manual is given in parenthesis as a synonym.

Wherever possible, duplicate specimens of all species that I have collected have been deposited in the herbarium of McMaster University, and a great majority of the specimens may also be found in the herbarium of the Division of Botany and Plant Pathology, Science Service, Dominion Department of Agriculture, Ottawa.

Only indigenous species are presented here from the original listing, since naturalized introduced plants have no bearing on the main topic of discussion.

PTERIDOPHYTA

Ophioglossaceae

Ophioglossum vulgatum L.
Botrychium simplex Hitchc.
Botrychium dissectum Sprenge. var. *oneidense* (Gilbert) Farw.
Botrychium dissectum f. *obliquum* (Muhl.) Fernald (B. obliquum Muhl.)
Botrychium virginianum (L.) Sw.

Polypodiaceae

Dennstaedtia punctilobula (Michx.) Moore[2] (Dicksonia punctilobula (Michx.) Gray.
Pteridium aquilinum (L.) Kuhn. var. *latiusculum* (Desv.) Underwood ex Heller (Pteris aquilina L.)
Adiantum pedatum L.
Pellaea glabella Mett. (P. atropurpurea (L.) Link. in part) (Amer. Fern. Jour. 7:77. 1917)
Pteretis nodulosa (Michx.) Nieuwl. (Onoclea Struthiopteris (L.) Hoffm.) (Rhodora 17:164. 1915)
Onoclea sensibilis L.
Camptosorus rhizophyllus (L.) Link.[3]
Asplenium Trichomanes L.
Athyrium thelypteroides (Michx.) Desv. (Asplenium acrostichoides Sw.)
Athyrium angustum (Willd.) Presl. (Asplenium Felix-femina (L.) Bernh. in part.) (Rhodora 19:169. 1917)
Cystopteris bulbifera (L.) Bernh.
Cystopteris fragilis (L.) Bernh.
Dryopteris linnaeana C. Chr. (Phegopteris Dryopteris (L.) Fee.)
Dryopteris noveboracensis (L.) A. Gray (Aspidium noveboracense (L.) Sw.)
Dryopteris Thelypteris (L.) A. Gray var. *pubescens* (Lawson) A. R. Prince ex Weatherby (Aspidium Thelypteris (L.) Sw.) (Rhodora 31:34. 1939)

[2] This forms a considerable stand at only one known locality in the county.

[3] This species has not been found in recent years and may be extinct.

Dryopteris marginalis (L.) A. GRAY (Aspidium marginale (L.) Sw.)
Dryopteris Goldiana (HOOK.) A. GRAY (Aspidium Goldianum HOOK.)
Dropteris cristata (HOOK.) A. GRAY (Aspidium cristatum (L.) Sw.
Dryopteris cristata var. *Clintoniana* (D. C. EATON) UNDERW. (Aspidium cristatum var. Clintonianum D. C. EATON)
Dryopteris spinulosa (O. F. MUELL.) WATT. (Aspidium spinulosum (O. F. MUELL.) Sw.
Dryopteris spinulosa var. *americana* (FISCH.) FERNALD (Aspidium spinulosum var. dilatatum f. anadenium ROBINSON)
Dryopteris spinulosa var. *intermedia* (MUHL.) UNDERW. (Aspidium spinulosum var. intermedium (MUHL.) D. C. EATON)
Polystichum acrostichoides (MICHX.) SCHOTT.
Polystichum Lonchitis (L.) ROTH.[4]
Polypodium virginianum L.[5] (P. vulgare L.) (Rhodora 24: 125. 1922)

Osmundaceae

Osmunda regalis L. var. *spectabilis* (WILLD.) A. GRAY (O. regalis L.) (Rhodora 32: 72. 1920)
Osmunda cinnamomea L.

Equisetaceae

Equisetum arvense L.
Equisetum sylvaticum var. *multiramosum* (FERNALD) WHERRY
Equisetum limosum L. (E. fluviatile L.) (Rhodora 23: 43. 1921)
Equisetum prealtum RAF. (E. hyemale var. affine (ENGELM.) A. A. EATON
Equisetum variegatum SCHLEICH.
Equisetum scirpoides MICHX.

Lycopodiaceae

Lycopodium lucidulum MICHX.
Lycopodium clavatum L.
Lycopodium obscurum L.
Lycopodium complanatum L.

Selaginellaceae

Selaginella apoda (L.) FERNALD (S. apus (L.) SPRING.) (Rhodora 17: 68. 1915)

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[4] This is one of Fernald's (1935) relict species. Its distribution as given by Fernald is Rocky Mts., Keweenaw Pen., Bruce Pen., L. Erie, Niagara Pen., Gaspe, Newfoundland and Greenland.

[5] Probably extinct since it has not been collected in recent years.

SPERMATOPHYTA

GYMNOSPERMAE

Taxaceae

Taxus canadensis MARSH.

Pinaceae

Pinus Strobus L.
Larix laricina (DU ROI) KOCH.
Picea mariana (MILL.) B.S.P.[6]
Tsuga canadensis (L.) CARR.
Abies balsamea (L.) MILL.[6]
Thuja occidentalis L.
Juniperus communis L. var. *depressa* PURSH.[7]
Juniperus virginiana L. var. *crebra* FERNALD & GRISCOM (Rhodora 37:131-133. 1935)

ANGIOSPERMAE

MONOCOTYLEDONEAE

Typhaceae

Typha latifolia L.
Typha angustifolia L.

Sparganiaceae

Sparganium eurycarpum ENGELM.
Sparganium americanum NUTT.
Sparganium chlorocarpum RYDB.
Sparganium minimum FRIES.

Potamogetonaceae

Potamogeton natans L.
Potamogeton epihydrus var. *Nuttallii* (CHAM. & SCHLECHT) FERNALD. (Mem. Gray Herb. III: 117. 1932)
Potamogeton alpinus BALBIS.
Potamogeton amplifolius TUCKERM.
Potamogeton gramineus L. var. *graminifolius* FRIES. (P. heterophyllus of recent authors)

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[6] Found most frequently in cold bogs in northern part of county.

[7] This has been found only along the banks of the Grand R., in the area south of Breslau, where the limestone comes close to the surface. According to Deam (1940, p. 70) the habitat of this species appears to be very diversified.

Potamogeton angustifolius BERSCH & PRESL.
Potamogeton lucens L.
Potamogeton praelongus WULF.
Potamogeton perfoliatus L.
Potamogeton zosteriformis FERN. (P. zosterifolius of American authors) (Mem. Gray Herb. III: 36-40. 1932)
Potamogeton pusillus L.
Potamogeton foliosus RAF.
Potamogeton filiformis PERS.
Potamogeton pectinatus L.

Najadaceae

Najas flexilis (WILLD.) ROSTK. & SCHMIDT.

Scheuchzeriaceae

Triglochin maritima L.
Triglochin palustris L.
Scheuchzeria palustris L. var. *americana* FERN. (S. palustris L.) (Rhodora 23: 177-179. 1923)

Alismaceae

Alisma subcordatum RAF. (A. Plantago-aquatica L.)
Sagittaria latifolia WILLD.
Sagittaria rigida PURSH. (S. heterophylla PURSH.)
Sagittaria graminea MICHX.

Hydrocharitaceae

Anacharis canadensis (MICHX.) PLANCH. (Elodea canadensis MICHX.)
Vallisneria americana MICHX. (V. spiralis L.) (Rhodora 20: 108. 1918)

Gramineae

Bromus ciliatus L.
Bromus ciliatus var. *laeviglumis* SCHRIBN.
Bromus purgans L.
Bromus Kalmii GRAY.
Festuca octoflora WALT.
Festuca obtusa SPRENG. (F. nutans SPRENG.)
Festuca rubra L.
Festuca rubra var. *lanuginosa* MERT. & KOCH.
Puccinellia distans (L.) PARL.
Glyceria borealis (NASH) BATCHELDER.
Glyceria septentrionalis HITCHC.

Glyceria fluitans (L.) R. Br.
Glyceria canadensis (Michx.) Trin.
Glyceria canadensis var. *laxa* (Scribn.) Hitchc. (G. laxa Scribn.)
Glyceria striata (Lam.) Hitchc. (G. nervata (Willd.) Trin.) (Proc. Biol. Soc. of Wash., 41: 157. 1928)
Glyceria grandis Wats.
Poa alsodes A. Gray.
Poa languida Hitchc. (P. debilis Torr.) (Proc. Biol. Soc. of Wash., 41: 158. 1928)
Poa saltuensis Fernald & Wiegand.
Poa palustris L. (P. triflora Gilib.)
Eragrostis pectinacea (Michx.) Nees.
Schizachne purpurascens (Torr.) Swallen. (Melica striata (Michx.) Hitchc.)
Agropyron Smithii Rydb.
Agropyron subsecundum (Link.) Hitchc. (A caninum (L.) Beauv.)
Agropyron pauciflorum (Schwein.) Hitchc. (A. tenerum Vasey.)
Elymus villosus Muhl. (E. striatus of recent authors not Willd.)
Elymus canadensis L.
Elymus riparius Wiegand (Rhodora 20: 84-86. 1918)
Elymus virginicus L.
Hystrix patula Moench.
Hystrix patula var. *Bigeloviana* (Fernald) Deam.
Hordeum jubatum L.
Hordeum vulgare var. *trifurcatum* (Schlecht.) Alefeld.
Koeleria cristata (L.) Pers.
Sphenopholis intermedia (Rydb.) Rydb. (S. pallens (Spreng.) Scrib.
Sphenopholis nitida (Spreng.) Scrib.
Trisetum melicoides (Michx.) Scrib.
Trisetum spicatum (L.) Richt.
Deschampsia caespitosa (L.) Beauv.
Danthonia spicata (L.) Beauv.
Calamagrostis canadensis (Michx.) Beauv.
Calamagrostis inexpansa A. Gray.
Calamagrostis neglecta (Ehrh.) Gaertn.
Agrostis stolonifera L.
Agrostis hiemalis (Walt.) B.S.P.
Agrostis perennans (Walt.) Tuckerm.
Cinna arundinacea L.
Cinna latifolia (Trevir.) Griseb.
Alopecurus aequalis Sobol. (A. geniculatus var. aristulatus Torr.)
Muhlenbergia tenuiflora (Willd.) B.S.P.

Muhlenbergia racemosa (MICHX.) B.S.P.
Muhlenbergia mexicana (L.) TRIN.
Muhlenbergia sylvatica TORR.
Muhlenbergia foliosa (ROEM. & SCHULT.) TRIN.
Sporobolus vaginiflorus (TORR.) WOOD.
Sporobolus neglectus NASH.
Sporobolus cryptandrus (TORR.) A. GRAY.
Brachyelytrum erectum (SCHREB.) BEAUV.
Oryzopsis asperifolia MICHX.
Oryzopsis racemosa (J. E. SMITH) RICKER.
Oryzopsis canadensis (POIR.) TORR.
Spartina pectinata LINK.
Spartina cynosuroides (L.) ROTH.
Hierochloe odorata (L.) BEAUV.
Leersia oryzoides (L.) SWARTZ.
Leersia virginica WILLD.
Zizania aquatica L.
Panicum linearifolium SCRIB.
Panicum microcarpon MUHL.
Panicum dichotomum L.
Panicum implicatum SCRIB.
Panicum huachucae var. *fasciculatum* (TORR.) F. T. HUBB. (P. huachucae var. silvicola HITCH. & CHASE.)
Panicum tennesseense ASHE
Panicum lanuginosum ELL.
Panicum xanthophysum A. GRAY.
Panicum latifolium L.
Panicum capillare L.
Andropogon scoparius MICHX.
Andropogon furcatus MUHL.
Sorghastrum nutans (L.) NASH.

Cyperaceae

Dulichium arundinaceum (L.) BRITTON.
Cyperus diandrus TORR.
Cyperus rivularis KUNTH.
Cyperus strigosus L.
Cyperus erythrorhizos MUHL.
Cyperus esculentus L.
Eriophorum spissum FERNALD (E. callitrix CHAM.) (Rhodora 27: 208-209. 1925)
Eriophorum gracile KOCH.

Eriophorum angustifolium ROTH.
Eriophorum viridi-carinatum (ENGELM.) FERNALD.
Eriophorum virginicum L.
Scirpus debilis PURSH.
Scirpus microcarpus PRESL.
Scirpus Smithii GRAY.
Scirpus americanus PERS.
Scirpus validus VAHL.
Scirpus fluviatilis (TORR.) GRAY.
Scirpus rubrotinctus FERNALD.
Scirpus atrovirens MUHL.
Scirpus lineatus MICHX.
Scirpus cyperinus (L.) KUNTH.
Scirpus cyperinus var. *pelius* FERNALD.
Eleocharis olivacea TORR.
Eleocharis ovata (ROTH.) R. & S.
Eleocharis intermedia (MUHL.) SCHULTES.
Eleocharis obtusa (WILLD.) SCHULTES.
Eleocharis palustris (L.) R. & S.
Eleocharis calva TORR.
Eleocharis acicularis (L.) R. & S.
Eleocharis compressa SULLIV. (E. acuminata (MUHL.) NEES.) (Rhodora 34: 215. 1932)
Eleocharis rostellata TORR.
Eleocharis pauciflora (LIGHTF.) LINK. var. *Fernaldii* SVENSON. (Scirpus pauciflorus LIGHTF.) (Rhodora 26: 380. 1934)
Fimbristylis autumnalis (L.) R. & S.
Cladium mariscoides (MUHL.) TORR. (Rhodora 25: 49. 1923)
Rhynchospora alba (L.) VAHL.
Rhynchospora capillacea TORR.
Scleria verticillata MUHL.
Carex siccata DEWEY[8] (c. foena WILLD.) (Rhodora 40: 325-329. 1938)
Carex chordorrhiza L. f.
Carex retroflexa MUHL.
Carex rosea SCHKUHR.
Carex convoluta MACK.
Carex radiata (WAHL.) DEWEY. (C. rosea var. radiata DEWEY.)
Carex cephalophora MUHL.
Carex Muhlenbergii SCHKUHR.
Carex cephaloidea DEWEY.
Carex sparganioides MUHL.

[8] The arrangement of species of *Carex* follows that of Mackenzie's monograph (1935).

Carex vulpinoidea MICHX.
Carex diandra SCHRANK.
Carex prairea DEWEY. (C. diandra var. ramosa (BOOTT.) FERNALD.)
Carex stipata MUHL.
Carex alopecoidea TUCKERM.
Carex disperma DEWEY. (C. tenella SCHKUHR.)
Carex trisperma DEWEY.
Carex brunnescens (PERS.) POIR.
Carex canescens L.
Carex canescens L. var. disjuncta FERNALD.
Carex arcta BOOTT.
Carex interior BAILEY. (C. scirpoides SCHKUHR. not C. scirpoidea MICHX.)
Carex sterilis WILLD.
Carex Deweyana SCHWEIN.
Carex Crawfordii FERNALD.
Carex scoparia SCHKUHR.
Carex Bebbii OLNEY.
Carex normalis MACK. (C. mirabilis DEWEY.)
Carex brevior (DEWEY) MACK. (C. festucacea var. brevior (DEWEY) FERNALD.)
Carex tribuloides WAHLENB.
Carex tribuloides var. *moniliformis* BRITTON.
Carex cristatella BRITT. (C. cristata SCHWEIN.)
Carex sychnocephala CAREY.
Carex leptalea WAHLENB.
Carex Jamesii SCHWEIN.
Carex Peckii HOWE.
Carex artitecta MACK. (C. varia MUHL.)
Carex Emmonsii DEWEY. (C. albicans of authors.) (Rhodora 40: 330-331. 1938)
Carex communis BAILEY.
Carex pennsylvanica LAM.
Carex pedunculata MUHL.
Carex hirtifolia MACK. (C. pubescens MUHL.) (Bull. Torrey Bot. Club 37: 244. 1910)
Carex eburnea BOOTT.
Carex aurea NUTT.
Carex tetanica SCHKUHR.
Carex Woodii DEWEY. (C. tetanica var. Woodii (DEWEY) BAILEY.)
Carex salutensis BAILEY. (C. vaginata TAUSCH.)
Carex plantaginea LAM.
Carex platyphylla CAREY.

Carex digitalis Willd.
Carex laxiculmis Schwein.
Carex ormostachya Wiegand.
Carex laxiflora Lam.
Carex albursina Sheldon. (C. laxiflora var. latifolia Boott.) (Rhodora 24: 189. 1922)
Carex blanda Dewey. (C. laxiflora var. varians of authors, not Bailey.) (Rhodora 24: 182. 1922)
Carex Haleana Olney. (C. granularis var. Haleana (Olney) Porter.)
Carex granularis Muhl.
Carex Crawei Dewey.
Carex Hitchcockiana Dewey.
Carex gracillima Schwein.
Carex arctata Boott.
Carex capillaris L. var. *elongata* Olney.
Carex Sprengelii Dewey. (C. longirostris Torr.)
Carex viridula Michx. (C. Oederi var. pumila (Cosson & Germain) Fernald.) (Journal of Bot. 77: 301-304. 1939)
Carex flava L.
Carex lanuginosa Michx.
Carex scabrata Schwein.
Carex limosa L.
Carex paupercula Michx.
Carex aquatilis Wahlenb.
Carex stricta Lam.
Carex stricta var. *strictior* (Dewey) Carey. (C. strictior Dewey.)
Carex pauciflora Lightf.
Carex Schweinitzii Dewey.
Carex hystricina Muhl.
Carex comosa Boott.
Carex pseudo-cyperus L.
Carex lacustris Willd.
Carex atherodes Spreng. (C. trichocarpa var. aristata (R. Br.) Bailey.)
Carex trichocarpa Muhl.
Carex rostrata Stokes. (Including C. rostrata var. utriculata (Boott.) Bailey.)
Carex Tuckermani Dewey.
Carex retrorsa Schwein.
Carex intumescens Rudge.
Carex lupulina Muhl.
Carex lupuliformis Sartwel.

Araceae

Acorus calamus L.
Symplocarpus foetidus (L.) Nutt.
Calla palustris L.
Arisaema Dracontium (L.) Schott.[9]
Arisaema atrorubens (Ait.) Blume. (A. triphyllum (L.) Schott. in part)
Arisaema atrorubens (Ait.) Blume f. *zebrinum* (Sim) Fernald. (A. triphyllum (L.) Schott. in part)

Lemnaceae

Spirodela polyrhiza (L.) Schleid.
Lemna trisulca L.
Lemna minor L.

Pontederiaceae

Heteranthera dubia (Jacq.) Macm.

Juncaceae

Juncus effusus L.
Juncus balticus Willd. var. *littoralis* Engelm.
Juncus balticus Willd. var. *littoralis* Engelm. f. *dissitiflorus* Engelm.
Juncus bufonius L.
Juncus macer S. F. Gray. (J. tenuis of authors, not Willd.) (Journal of Bot. 68: 367. 1930)
Juncus Dudleyi Wiegand.
Juncus canadensis J. Gay.
Juncus brachycephalus (Englem.) Buch.
Juncus acuminatus Michx.
Juncus nodosus L.
Juncus alpinus Vill. var. *rariflorus* Hart. (J. alpinus var. insignis Fries.) (Rhodora 35: 233. 1933)
Juncus alpinus var. *fuscescens* Fernald.
Luzula carolinae S. Wats. var. *saltuensis* (Fernald) Fernald. (L. saltuensis Fernald) (Rhodora 40: 404. 1938)
Luzula campestris (L.) DC.
Luzula campestris (L.) DC. var. *multiflora* (Ehrh.) Celak.

Liliaceae

Tofieldia glutinosa (Michx.) Pers.

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[9] Frère Marie-Victorin (1935), states that this is essentially a plant of the Mississippi Basin. Specimens from Seaforth, London, Holmesville, are in Toronto University herbarium; from Clinton, at Ontario Agricultural College. It is quite plentiful in the localities where I have found it.

Zygadenus glaucus Nutt. (Z. chloranthus Richards.) (Rhodora 37: 256-258. 1935)
Uvularia grandiflora J. E. Smith.
Allium tricoccum Ait.
Allium canadense L.
Lilium philadelphicum L.
Lilium michiganense Farw.[10]
Erythronium albidum Nutt.
Erythronium americanum Ker.
Clintonia borealis (Ait.) Raf.
Smilacina racemosa (L.) Desf.
Smilacina stellata (L.) Desf.
Smilacina trifolia (L.) Desf.
Maianthemum canadense Desf.
Streptopus roseus Michx.
Polygonatum pubescens (Willd.) Pursh.[11] (P. biflorum (Walt.) Ell.) (See Deam (1940), and Rhodora 46: 9-12. 1944)
Medeola virginiana L.
Trillium erectum L.
Trillium grandiflorum (Michx.) Salisb.
Trillium cernuum L. var. *macranthum* Eames & Wiegand[12] (Rhodora 25: 191. 1923)
Smilax herbacea L.
Smilax rotundifolia L.
Smilax hispida Muhl.

Dioscoreaceae

Dioscorea villosa L. f. *glabrifolia* (Bartlett) Fernald.[13]

Iridaceae

Iris versicolor L.
Sisyrinchium albidum Raf.
Sisyrinchium angustifolium Mill.
Sisyrinchium graminoides Bickn. (S. gramineum Curtis.)

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[10] All my specimens have been identified by J. H. Soper as *L. michiganense*. However, there is much doubt as to the validity of *L. michiganense* as a species separate from *L. superbum*. See E. D. Hull, Rhodora 45: 512-515, 1944.

[11] See Deam (1940) p. 319 and Fernald, Rhodora 46: 9-12. 1944.

[12] A rare species in this county, and, since it is more northern in range it is probably rare throughout southwestern Ontario. Mr. Landon of Simcoe claims he has a specimen found in Norfolk county.

[13] No specimens have been found for many years since the woods in the vicinity in which it was found have been considerably reduced. It is likely extinct.

Orchidaceae

Cypripedium reginae Walt. (C. hirsutum Mill.)
Cypripedium parviflorum Salisb.
Cypripedium parviflorum Salisb. var. *pubescens* (Willd.) Knight.[14]
Cypripedium acaule Ait.
Orchis spectabilis L.
Habenaria dilatata (Pursh.) Gray.
Habenaria hyperborea (L.) R. Br.
Habenaria orbiculata (Pursh.) Torr.
Habenaria lacera (Michx.) R. Br.
Habenaria psycodes (L.) Sw.
Pogonia ophioglossoides (L.) Ker.
Arethusa bulbosa L.
Spiranthes gracilis (Bigel.) Beck.
Spiranthes lucida (H. H. Eaton) Ames.
Spiranthes cernua (L.) Richard.
Spiranthes Romanzoffiana Cham.
Goodyera repens var. *ophioides* (Fernald) A. A. Eaton. (Epipactus repens (L.) Crantz var. ophioides (Fernald) A. A. Eaton.
Goodyera decipiens Hubbard. (Epipactus decipiens (Hook.) Ames.
Goodyera pubescens R. Br. (Epipactus pubescens (Willd.) A. A. Eaton.
Calopogon pulchellus (Sw.) R. Br.
Corallorrhiza trifida Chatelain.
Corallorrhiza maculata Raf.
Corallorrhiza striata Lindl.
Malaxis unifolia Michx. (Microstylis monophyllos (L.) Lindl.)
Liparis Loeselii (L.) Richard.
Aplectrum hymenale (Muhl.) Torr.

DICOTYLEDONEAE

Saururaceae

Saururus cernuus L.

Salicaceae

Populus alba L.
Populus Tacamahacca Mill. (P. balsamifera L.)
Populus deltoides Marsh.
Populus grandidentata Michx.

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[14] Correll (1938) says that our *C. parviflorum var. pubescens* is a variety of the yellow lady slipper of Eurasia, and gives it the name *C. calceolus var. pubescens* (Willd.) Correll. See Bot. Leaflet of Harvard University 7: 1-18. 1938.

Populus tremuloides MICHX.
Salix nigra MARSH.
Salix amygdaloides ANDERS.
Salix serissima (BAILEY) FERNALD.[15]
Salix lucida MUHL.
Salix interior ROWLEE. (S. longifolia MUHL.)
Salix discolor MUHL.
Salix petiolaris SM.
Salix sericea MARSH.
Salix humilis MARSH.
Salix Bebbiana SARG. (S. rostrata RICHARDSON.)
Salix pedicellaris PURSH var. hypoglauca FERNALD. (S. pedicellaris PURSH.)
Salix candida FLUGGE.
Salix cordata MUHL.
Salix cordata var. *angustata* ANDERS.

Myricaceae

Comptonia peregrina (L.) COULTER. (Myrica asplenifolia L.) (Rhodora 40: 408-412. 1938)

Juglandaceae

Juglans cinerea L.
Juglans nigra L.[16]
Carya cordiformis (WANG.) K. KOCH.
Carya ovata (MILL.) K. KOCH.
Carya glabra (MILL.) SPACH.[17]

Betulaceae

Carpinus caroliniana WALT. (Rhodora 37- 425. 1935)
Ostrya virginiana (MILL.) K. KOCH.
Corylus americana WALT.
Corylus cornuta MARSH. (C. rostrata AIT.)
Betula lenta L.
Betula lutea MICHX. f.
Betula populifolia MARSH.

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[15] This is a late flowering and fruiting species. It is interesting to see the fruit still on the shrubs late in September. It is described as a northern plant of limy regions by Wiegand and Eames (1925).

[16] A few trees appearing to be indigenous occur as far north as Preston.

[17] Of the hickories only *C. cordiformis* has been found north of Galt, and it is found usually as isolated trees scattered throughout the area.

Betula papyrifera Marsh. (B. alba L. var. papyrifera (Marsh.) Spach.
Betula papyrifera Marsh. var. *cordifolia* (Reg.) Fernald.
Betula pumila L.
Betula glandulosa Michx.[18]
Alnus incana (L.) Moench. var. *americana* Regel. (A. incana (L.) Moench.)

Fagaceae

Fagus grandifolia Ehrh.
Castanea dentata (Marsh.) Borkh.[19]
Quercus alba L.
Quercus prinoides Willd.
Quercus Muhlenbergii Engelm.[20]
Quercus macrocarpa Michx.
Quercus borealis Michx. var. *maxima* (Marsh.) Ashe. (Q. rubra L.) (Rhodora 41: 521-524. 1939)
Quercus coccinea Muench.
Quercus velutina Lamb.[21]

Ulmaceae

Ulmus fulva Michx.
Ulmus racemosa Thomas.[22]
Ulmus americana L.
Celtis occidentalis L.[23]

Urticaceae

Humulus americana Nutt. (H. lupulus L. of American authors.)
Urtica procera Muhl. (U. gracilis Ait.) (Rhodora 29: 195. 1926)
Urtica Lyallii Wats.
Laportea canadensis (L.) Gaud.
Pilea pumila (L.) Gray.
Boehmeria cylindrica (L.) Sw.

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[18] A northern species that occurs in some abundance with *B. pumila* at the locality where it was found.

[19] One of my specimens was in flower and bearing fruit of the previous year. The upper part of the tree was dead and the tips of the branches of the lower limbs were showing signs of the Chestnut Blight. There are quite a number of small trees of second growth in the southern part of the county.

[20] Herriot claimed that this specimen is indigenous.

[21] Only *Q. macrocarpa*, *Q. borealis* var. *maxima* and *Q. alba* have been collected north of Galt in this county.

[22] Seen only along the flat of rivers and streams in the county.

[23] Two large trees occur at the bridge at Blair and these are undoubtedly native. Trees found further north are much smaller. The most northerly collections have been made near the village of Conestoga.

Santalaceae

Comandra Richardsoniana FERNALD.[24]

Aristolochiaceae

Asarum canadense L.

Polygonaceae

Rumex verticillatus L.

Rumex Britannica L.

Rumex persicarioides L.

Polygonum natans EATON f. *genuinum* STANFORD.

Polygonum natans f. *Hartwrightii* (GRAY) STANFORD. (P. amphibium var. Hartwrightii (GRAY) BISSEL.)

Polygonum coccineum MUHL.[25]

Polygonum pennsylvanicum L. var. *laevigatum* FERNALD. (P. pennsylvanica (L.) SMALL in part)

Polygonum pennsylvanicum L. var. *laevigatum* f. *pallescens* STANFORD. (P. pennsylvanica (L.) SMALL in part)

Polygonum Careyi OLNEY.

Polygonum Hydropiper L. var. *projectum* STANFORD. (P. Hydropiper L. in part.) (Rhodora 29: 77-87. 1927)

Polygonum punctatum ELL. (P. acre H.B.K.) (Rhodora 29: 77-87. 1927)

Polygonum hydropiperoides MICHX.

Polygonum sagittatum L.

Polygonum scandens L.

Polygonum achoreum BLAKE.

Chenopodiaceae

Chenopodium capitatum (L.) ASCH.

Chenopodium gigantospermum AELLEN. (C. hybridum of American authors not L.) (Rep. Spec. Nov. Regn. Veget. 26: 144. 1929)

Atriplex patula L. var. *hastata* (L.) GRAY.

Amaranthaceae

Amaranthus graecizans L.

Portulacaceae

Claytonia virginica L.

Claytonia caroliniana MICHX.

[24] This species has not been collected north of Galt.

[25] The writer has followed Deam (1940, p. 412) in referring specimens designated as *P. Muhlenbergii* (MEISN.) WATS. and *P. emersum* (MICHX.) BRITT. to *P. coccineum* MUHL.

Caryophyllaceae

Stellaria borealis Bigel.
Stellaria longifolia Muhl.
Cerastium arvense L.
Arenaria stricta Michx.
Silene stellata var. *scabrella* Nieuwland. (S. stellata in part) (Amer. Midland Nat. 3: 58-59. 1913)
Silene antirrhina L.

Nymphaeaceae

Brasenia Schreberi Gmel.
Nymphaea odorata Ait. (Castalia odorata (Ait.) Woodville & Wood.)
Nuphar advena Ait. (Nymphaea advena Ait.) (Rhodora 39: 407-409. 1937)

Ceratophyllaceae

Ceratophyllum demersum L.

Ranunculaceae

Caltha palustris L.
Coptis groenlandica (Oeder) Fernald. (C. trifolia (L.) Salisb.) (Rhodora 31: 136-142. 1929)
Actaea alba (L.) Mill.[26] (See Mackenzie, Torreya 28: 51-52. 1928, and Fernald, Rhodora 42: 260-264. 1940, and Gleason, Rhodora 46: 146-148. 1944.)
Actaea pachypoda Ell.
Actaea rubra (Ait.) Willd.
Cimicifuga racemosa (L.) Nutt.[27]
Aquilegia canadensis L.
Anemone quinquefolia L. (Rhodora 37: 260. 1935)
Anemone canadensis L.
Anemone cylindrica Gray.
Anemone riparia Fernald.
Anemone virginiana L.
Anemonella thalictroides (L.) Spach.
Hepatica acutiloba DC.
Hepatica americana (DC.) Ker.[28] (H. triloba Chaix.) (Rhodora 19: 45-46. 1917)

[26] Several specimens have been found at one locality. It has also been collected on limestone cliffs in Dufferin county.

[27] Undoubtedly extinct here.

[28] *H. americana* has not been found in this county north of Preston, yet it does occur in the Bruce Peninsula, Krotkov (1940), and in L. Superior area, Hosie (1935).

Clematis virginiana L.
Ranunculus flabellaris Raf. (R. delphinifolius Torr.)
Ranunculus trichophyllus Chaix. var. *typicus* Drew. (R. aquatilis var. capillaceus DC.) (Rhodora 38: 18-29. 1936)
Ranunculus abortivus L.
Ranunculus scleratus L.
Ranunculus recurvatus Poir.
Ranunculus acris L.
Ranunculus fascicularis Muhl.
Ranunculus pennsylvanicus L.
Ranunculus repens L.
Ranunculus hispidus Michx.
Ranunculus septentrionalis Poir.
Ranunculus septentrionalis var. *caricetorum* (Greene) Fernald. (Rhodora 38: 177-178. 1936)
Thalictrum dioicum L.
Thalictrum dasycarpum Fisch & Lall.
Thalictrum polygamum Muhl.

Berberidaceae

Podophyllum peltatum L.
Jeffersonia diphylla (L.) Pers.
Caulophyllum thalictroides (L.) Michx.

Menispermaceae

Menispermum canadense L.

Lauraceae

Sassafras albidum (Nutt.) Nees[29] (S. variifolium (Salisb.) Ktze. (Rhodora 38: 178-179. 1936)
Lindera benzoin (L.) Blume. (Benzoin aestivale (L.) Nees.

Papaveraceae

Sanguinaria canadensis L.

Fumariaceae

Dicentra canadensis (Goldie) Walp.
Dicentra Cucullaria (L.) Bernh.
Adlumia fungosa (Ait.) Greene.[30]

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[29] This reaches the southern borders of the county. There is a considerable stand at the locality where it was found.

[30] Herriot collected his specimens in 1895, and remarked that he had not noticed it in later years. It is probably now extinct.

Cruciferae

Lepidium virginicum L.

Rorippa islandica BORBAS var. *microcarpa* (REGEL.) FERNALD. (Radicula palustris (L.) MOENCH. & Radicula palustris (L.) MOENCH. var. hispida (DESV.) ROBINSON. (Rhodora 42: 271-273. 1940)

Cardamine bulbosa (SCHREB.) BSP.

Cardamine Douglassii (TORR.) BRITT.[31]

Cardamine pratensis L. var. *palustris* WIMM. & GRAB. (C. pratensis L.) (Rhodora 22: 14. 1920)

Cardamine pennsylvanica MUHL.

Dentaria laciniata MUHL.

Dentaria diphylla MICHX.

Dentaria heterophylla NUTT.

Dentaria maxima NUTT.[32]

Arabis pycnocarpa HOPKINS. (A. hirsuta of American authors.) (Rhodora 39: 112. 1937)

Arabis glabra (L.) BERNH.

Arabis brachycarpa (T. & G.) BRITTON.

Arabis canadensis L.

Erysimum cheiranthoides L.

Sarraceniaceae

Sarracenia purpurea L.

Droseraceae

Drosera rotundifolia L.

Drosera intermedia HAYNE. (D. longifolia of manuals, not L.)

Crassulaceae

Penthorum sedoides L.

Saxifragaceae

Saxifraga virginiensis MICHX.

Tiarella cordifolia L.

Mitella diphylla L.

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[31] It seems very difficult to segregate *C. bulbosa* and *C. Douglassii* on appearances only. My specimens have been identified according to plant characteristics, for, if we were to consider the habitat as given by Deam (1940, p. 498) then my specimens should be *C. bulbosa*. It might be better to do as some authors have suggested (see Deam 1940, p. 498, and Wiegand and Eames 1925, p. 233), and consider *C. Douglassii* as a variety of *C. bulbosa*.

[32] Wiegand and Eames (1925, p. 232) believe that *D. maxima* is of hybrid origin, with *D. diphylla* and *D. laciniata* as parents.

Mitella nuda L.
Chrysoplenium americanum SCHWEIN.
Parnassia glauca RAF. (P. caroliniana MICHX.) (Bartonia 17: 18. 1935)
Ribes americanum MILL. (R. floridum L'HER.)
Ribes Cynosbati L.
Ribes oxyacanthoides L.
Ribes triste PALLAS.
Ribes triste PALLAS. var. *albinervium* (MICHX.) FERNALD.

Hamamelidaceae

Hamamelis virginiana L.

Platanaceae

Platanus occidentalis L.

Rosaceae

Physocarpus opulifolius (L.) MAXIM.
Spiraea alba DU ROI. (S. salicifolia L. in part)
Malus coronaria (L.) MILL. (Pyrus coronaria L.)
Aronia prunifolia (MARSH.) REHDER. (Pyrus arbutifolia var. atropurpurea (BRITT.) ROBINSON) (Journal Arnold Arboretum 19: 74. 1938, and Torreya 33: 22-24. 1933)
Amelanchier canadensis (L.) MEDIC.
Amelanchier spicata (LAM.) C. KOCH.
Amelanchier alnifolia NUTT.[33]
Crataegus crus-galli L.
Crataegus punctata JACQ.
Crataegus coccinea L.
Crataegus macrosperma ASHE.
Rubus odoratus L.
Rubus pubescens RAF. (R. triflorus RICHARDSON) (Rhodora 11: 236. 1909)
Rubus occidentalis L.
Rubus idaeus var. *strigosus* (MICHX.) MAXIM. (Rhodora 21: 96. 1919)
Rubus allegheniensis PORTER.
Rubus argutus LINK.
Rubus nigricans RYDB.
Dalibarda repens L.
Fragaria virginiana DUCHESNE.
Fragaria virginiana DUCHESNE. var. *illinoensis* (PRINCE) GRAY.
Potentilla fruticosa L.
Potentilla arguta PURSH.

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[33] Rydberg (1932) considers this species to be a Western Plain and Montane species.

Potentilla Anserina L.
Potentilla palustris (L.) Scop.
Potentilla argentea L.
Potentilla simplex Michx. var. *typica* Fernald. (P. canadense L.) (Rhodora 33: 180-191. 1931)
Waldsteinia fragarioides (Michx.) Trattinick.
Geum rivale L..
Geum triflorum Pursh.
Geum canadense Jacq.
Geum virginianum L.[34]
Geum macrophyllum Willd.
Geum aleppicum Jacq. var. *strictum* (Ait.) Fernald. (G. strictum Ait.) (Rhodora 37: 294. 1935)
Agrimonia gryposepala Wallr.
Agrimonia pubescens Wallr. (A. mollis (T. & G.) Britton. (North Amer. Flora 22: 393. 1913)
Rosa carolina L. (R. humilis Marsh.)
Rosa blanda Ait.
Rosa Woodsii Lindl.[35]
Prunus americana Marsh.
Prunus nigra Ait.
Prunus pennsylvanica L. f.
Prunus virginiana L.
Prunus serotina Ehrh.
Prunus spinosa L.

Leguminosae

Lupinus perennis L.[36]
Astragalus canadensis L.[37]
Astragalus neglectus (T. & G.) Sheldon.
Glycyrrhiza lepidota (Nutt.) Pursh.[38]
Desmodium nudiflorum (L.) DC.[37]
Desmodium acuminatum (Michx.) DC. (D. grandiflorum (Walt.) DC.)
Desmodium bracteosum (Michx.) DC.
Desmodium canadense (L.) DC.
Desmodium paniculatum (L.) DC.

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[34] The collective species name *G. virginiana L.* has been retained here although Fernald (1935) has revised the nomenclature of the species in Rhodora 37: 39. 1935.

[35] According to Gray's Manual (1907) and Rydberg (1932) this is a western species.

[36] Has probably become extinct in our county

[37] Species of *Astragalus*, *Desmodium*, *Lespedeza*, and *Lathyrus* have not been collected north of Preston.

[38] This may have been introduced from the west.

Desmodium Dillenii Darl.
Desmodium marilandicum (L.) DC.
Lespedeza capitata Michx.[37]
Lespedeza hirta (L.) Hornem.
Lespedeza intermedia (Wats.) Britt. (L. frutescens (L.) Britt.) (Rhodora 26: 31. 1924)
Lespedeza violacea (L,) Pers.
Vicia caroliniana Walt.
Vicia americana Muhl.
Lathyrus venosum Muhl. var. *intonsus* Butters & St. John.[37]
Lathyrus ochroleucus Hook.
Amphicarpa bracteata (L.) Fernald. (A. monoica (L.) Ell.) (Rhodora 35: 276. 1933)
Apios americana Medic. (A. tuberosa Moench.)

Geraniaceae

Geranium maculatum L.
Geranium Robertianum L.
Geranium nemorale var. *Bicknellii* (Britt.) Fernald. (G. Bicknellii Britt.) (Rhodora 43: 35. 1941)

Oxalidaceae

Oxalis montana Raf. (O. Acetosella L.) (Rhodora 22: 143-144. 1920)
Oxalis stricta L.

Linaceae

Linum medium (Planch.) Trel. var. *texanum* (Planch.) Fernald. (L. medium (Planch.) Britt.) (Rhodora 37: 428. 1935)

Rutaceae

Zanthoxylum americanum Mill.

Polygalaceae

Polygala paucifolia Willd.
Polygala polygama var. *obtusata* Chodat. (P. polygama Walt.) (Rhodora 42: 458-459. 1940)
Polygala senega L.
Polygala verticillata L.

Euphorbiaceae

Acalpha rhomboidea Raf. (A. virginica of recent authors, not L.)
Euphorbia maculata L. (E. Preslii (Guss.) Arth.) (Contr. Gray Herb. 127: 74. 1939)

Euphorbia hirsuta (TORR.) WIEGAND.
Euphorbia humistrata ENGELM.
Euphorbia vermiculata RAF.
Euphorbia corollata L.

Callitrichaceae

Callitriche palustris L.

Limnanthaceae

Floerkea proserpinacoides WILLD.

Anacardiaceae

Rhus Vernix L.
Rhus typhina L.
Rhus radicans L.[39] (R. Toxicodendron L.)
Rhus aromatica AIT. (R. canadensis MARSH.)

Aquifoliaceae

Ilex verticillata (L.) GRAY.
Nemopanthus mucronata (L.) TREL.

Celastraceae

Evonymus atropurpureus JACQ.
Evonymus obovatus NUTT.
Celastrus scandens L.

Staphyleaceae

Staphylea trifolia L.

Aceraceae

Acer spicatum LAM.
Acer negundo L. var. *violaceum* (KIRCHN.) JACQ.
Acer saccharinum L.
Acer rubrum L.
Acer nigrum MICHX. f.[40] (A. saccharum MARSH. var. nigrum (MICHX. f.) BRITTON.
Acer saccharum MARSH.

Balsaminaceae

Impatiens biflora WALT.
Impatiens pallida NUTT.[41]

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[39] Both the erect and climbing forms are frequent in the county.

[40] This has been observed growing only along the flats of the rivers in the county.

[41] It has been observed that white flowers forms of *I. pallida* are as common or more common than the pale yellow flowers at one locality where it was collected.

Rhamnaceae

Rhamnus alnifolia L'HER.
Ceanothus americanus L.

Vitaceae

Vitis aestivalis MICHX.
Vitis riparia MICHX. (Vitis vulpina L.) (Rhodora 41: 431-434. 1939)
Parthenocissus quinquefolia (L.) PLANCH. (Psedera quinquefolia (L.) Greene.)
Parthenocissus inserta (KERN.) K. KRITSCH. (Psedera vitacea (KNERR) GREENE.) (Jour. Arnold Arb. 20: 419. 1939)

Tiliaceae

Tilia americana L.

Guttiferae

Hypericum Ascyron L.
Hypericum punctatum LAM.
Hypericum majus (GRAY) BRITTON.
Hypericum boreale (BRITTON) BICKNELL.
Hypericum canadense L.
Hypericum virginicum L. var. *Fraseri* (SPACH.) FERNALD. (H. virginicum in part) (Rhodora 38: 434. 1936)

Cistaceae

Helianthemum Bicknellii FERNALD. (H. majus BSP.) (Rhodora 21: 36-37. 1919)
Lechea intermedia LEGGETT.

Violaceae

Viola cucullata AIT.
Viola cucullata AIT. X *papilionacea* PURSH.
Viola nephrophylla GREENE.
Viola sororia WILLD.
Viola sagittata AIT.
Viola sagittata AIT. var. *ovata* (NUTT.) T. & G. (V. fimbriatula SMITH.)
Viola Selkirkii PURSH.
Viola pallens (BANKS) BRAINERD.
Viola blanda WILLD.
Viola eriocarpa SCHWEIN. (V. scabriuscula SCHWEIN.)
Viola eriocarpa SCHWEIN. f. *leiocarpa* (FERNALD & WIEG.) DEAM. (Rhodora 23: 275. 1921)
Viola pubescens AIT.

Viola pubescens Ait. X *eriocarpa* Schwein.
Viola renifolia Gray.
Viola canadensis L.
Viola conspersa Reichenb.
Viola labradorica Schrank.
Viola rostrata Pursh.

Thymelaeaceae

Dirca palustris L.

Elaeagnaceae

Shepherdia canadensis (L.) Nutt.

Oenotheraceae

Ludwigia palustris (L.) Ell. var. *americana* (DC.) Fernald & Grisc. (L. palustris (L.) Ell. in part) (Rhodora 37: 176-177. 1935)
Epilobium angustifolium L.
Epilobium strictum Muhl. (E. molle Torr.)
Epilobium densum Raf.
Epilobium palustre L.
Epilobium coloratum Muhl.
Epilobium glandulosum Lehm. var. *adenocaulon* (Haussk.) Fernald. (E. adenocaulon Haussk.) (Rhodora 20: 34. 1918)
Oenothera biennis L.
Oenothera cruciata Nutt.
Oenothera perennis L. var. *typica* Munz. (O. pumila L.) (Rhodora 25: 47. 1923) (Bul. Torr. Bot. Club 46: 372. 1919)
Circaea latifolia Hill. (C. lutetiana of authors, not L.) (Rhodora 17: 222. 1915 and 19: 87. 1917)
Circaea alpina L.

Haloragidaceae

Myriophyllum exalbescens Fernald. (M. spicatum L.) (Rhodora 21: 120. 1919)
Myriophyllum heterophyllum Michx.
Myriophyllum verticillatum L.
Proserpinaca palustris L. (Rhodora 37: 177-178. 1935)

Araliaceae

Aralia nudicaulis L.
Aralia racemosa L.
Panax quinquefolium L.[42]
Panax trifolium L.

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[42] Very rare in this county. It has also been collected in Dufferin county.

Umbelliferae

Hydrocotyle americana L.
Sanicula marilandica L.
Sanicula gregaria BICKNELL.
Sanicula canadensis L.
Sanicula trifoliata BICKNELL.
Osmorhiza Claytoni (MICHX.) CLARKE.
Osmorhiza longistylis (TORR.) DC.
Erigenia bulbosa (MICHX.) NUTT.
Zizia aurea (L.) KOCH.
Cicuta bulbifera L.
Cicuta maculata L.
Cryptotaenia canadensis (L.) DC.
Taenidia integerrima (L.) DRUDE.[43]
Sium suave WALT. (S. cicutaefolium SCHRANK.) (Rhodora 17: 131. 1915)
Conioselinum chinense (L.) BSP.
Angelica atropurpurea L.
Heracleum lanatum MICHX.

Cornaceae

Cornus canadensis L.
Cornus alternifolia L. f.
Cornus rugosa LAM. (C. circinata L'HER.)
Cornus stolonifera MICHX.
Cornus racemosa LAM. (C. paniculata L'HER.)
Cornus amomum MILL.

Ericaceae

Chimaphila umbellata (L.) BART. var. *cisatlantica* BLAKE. (C. umbellata (L.) NUTT. in part) (Rhodora 19: 241. 1917)
Pyrola secunda L.
Pyrola elliptica NUTT.
Pyrola virens SCHWEIGG. (P. chlorantha SW.) (Rhodora 43: 167. 1941)
Pyrola rotundifolia L. var. *americana* (SWEET) FERNALD. (P. americana SWEET.) (Rhodora 22: 122. 1920)
Pyrola asarifolia MICHX.
Pyrola asarifolia MICHX. var. *incarnata* (FISCH.) FERNALD.
Moneses uniflora (L.) GRAY.
Monotropa uniflora L.
Monotropa Hypopitys L. var. *rubra* (TORR.) FARW. (M. Hypopitys L.) (Amer. Midland Nat. 10: 39. 1926)

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[43] Seems to be restricted to the southern part of the county.

Ledum groenlandicum OEDER.
Kalmia polifolia WANG.
Andromeda glaucophylla LINK.
Chamaedaphne calyculata (L.) MOENCH.
Epigaea repens L.[44]
Gaultheria procumbens L.
Chiogenes hispidula (L.) T. & G.
Arctostaphylos Uva-ursi (L.) SPRENG. var. *coactilis* FERNALD & MACB. (A. Uva-ursi (L.) SPRENG.) (Rhodora 16: 212. 1914)
Gaylussacia baccata (WANG.) K. KOCH.
Vaccinium corymbosum L.
Vaccinium angustifolium AIT. (V. pennsylvanicum LAM.)
Vaccinium angustifolium AIT. var. *nigrum* (WOOD.) DOLE. (V. pennsylvanicum LAM. var. nigrum WOOD.)
Vaccinium canadense KALM.
Vaccinium macrocarpon AIT.
Vaccinium oxycoccus L.

Primulaceae

Primula mistassinica MICHX.
Samolus parviflorus RAF. (S. floribundus HBK.)
Lysimachia thyrsiflora L.
Lysimachia quadrifolia L.
Lysimachia terrestris (L.) BSP.
Lysimachia ciliata L. (Steironema ciliatum (L.) RAF.)
Lysimachia longifolia PURSH. (Steironema quadriflorum (SIMS) HITCHC.) (Pflanzenfam. IV, 237: 279. 1905)
Trientalis borealis RAF. (T. americana (PERS.) PURSH.) (Rhodora 11: 236. 1909)

Oleaceae

Fraxinus americanus L.
Fraxinus pennsylvanica MARSH.[45]
Fraxinus nigra MARSH.

Gentianaceae

Gentiana crinata FROEL.
Gentiana quinquefolia L.
Gentiana Andrewsii GRISEB.
Halenia deflexa (SM.) GRISEB.

[44] Older residents say that this used to be quite common throughout the area. To-day it is quite rare.

[45] No specimens have been seen north of Galt.

Menyanthes trifoliata L. var. *minor* RAF. (M. trifoliata L. of American authors) (Rhodora 31: 195-198. 1929)

Apocynaceae

Apocynum androsaemifolium L.
Apocynum cannabinum L.
Apocynum cannabinum L. var. *glaberrimum* A.D.C.
Apocynum cannabinum L. var. *hypericifolium* (AIT.) GRAY.

Asclepiadaceae

Asclepias tuberosa L.
Asclepias incarnata L.
Asclepias phytolaccoides PURSH.
Asclepias syriaca L.

Convolvulaceae

Cuscuta Gronovii WILLD.
Convolvulus spithamaeus L.
Convolvulus sepium L.

Polemoniaceae

Phlox divaricata L.
Phlox subulata L.

Hydrophyllaceae

Hydrophyllum canadense L.
Hydrophyllum virginianum L.

Boraginaceae

Cynoglossum virginianum L.
Lappula deflexa (WAHL.) GARCKE.
Hackelia virginiana (L.) I. M. JOHNSTON. (Lappula virginiana (L.) GREENE.) (CONTR. Gray Herb. Harvard Univ. 70: 1-55. 1924)
Myosotis laxa LEHM.
Lithospermum latifolium MICHX.
Lithospermum canescens (MICHX.) HITCHC.
Onosmodium hispidissimum MACK.

Verbenaceae

Verbena urticaefolia L.
Verbena hastata L.
Verbena simplex LEHM. (V. angustifolia MICHX.)
Verbena stricta VENT.

Labiatae

Teucrium canadense var. *virginianum* (L.) Eaton. (T. canadense of manuals, not L.)

Scutellaria galericulata L. (S. epilobifolia Hamilton.) (Rhodora 23: 85-86. 1921)

Scutellaria lateriflora L.

Agastache nepetoides (L.) Ktze.

Prunella vulgaris var. *lanceolata* (Bart.) Fernald. (P. vulgaris in part) (Rhodora 15: 179-186. 1913)

Stachys hispida Pursh. (S. tenuifolia var. asper (Michx.) Fernald.)

Stachys palustris L.

Stachys palustris L. var. *homotricha* Fernald. (Rhodora 10: 85. 1908)

Monarda didyma L.

Monarda fistulosa L. var. *mollis* (L.) Benth.

Hedeoma pulegioides (L.) Pers.

Satureja vulgaris (L.) Fritsch.

Satureja glabra (Nutt.) Fernald. (See Rhodora 42: 7. 1940)[46]

Pycnanthemum virginianum (L.) Durand & Jackson.

Lycopus uniflorus Michx.

Lycopus virginicus L.

Lycopus americanus Muhl.

Mentha arvensis L.[47]

Collinsonia canadensis L.

Solanaceae

Physalis subglabrata Mackenzie & Bush.

Physalis pruinosa L.

Physalis heterophylla Nees.

Solanum nigrum L.

Scrophulariaceae

Scrophularia lanceolata Pursh. (S. leporella Bicknell.)

Chelone glabra L.

Pentstemon hirsutus (L.) Willd.

Pentstemon laevigatus Ait.

Mimulus ringens L.

Mimulus moschatus Dougl.

Lindernia dubia (L.) Pennell var. *typica* Pennell. (Ilysanthes dubia (L.) Barnh.)

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[46] The name *S. glabella* var. *angustifolia* (Torr.) Svenson has been proposed for this species.

[47] Deam (1940, p. 825) has been followed here and varieties of *M. arvensis* have been included under the typical species.

Veronica peregrina L.
Veronica scutellata L.
Veronica americana (RAF.) SCHWEIN.
Veronica Anagallis-aquatica L.
Gerardia paupercula var. *borealis* (PENNELL) PENNELL. (Proc. Acad. Nat. Sci. Philadelphia 81: 159. 1929)
Gerardia tenuifolia WAHL.
Aureolaria flava (L.) FARW. var. *typica* PENNELL[48] (Gerardia virginica (L.) BSP. in part)
Aureolaria virginica (L.) PENNELL. (Gerardia flava L.)
Aureolaria pedicularia var. *ambigens* (FERNALD) FARW. (Gerardia pedicularia var. ambigens FERNALD.)
Castilleja coccinea (L.) SPRENG.
Melampyrum lineare LAM.
Pedicularis canadensis L.

Orobanchaceae

Conopholis americana (L.) WALLR.
Orobanche uniflora L. var. *typica* ACHEY.
Epifagus virginiana (L.) BART.

Lentibulariaceae

Utricularia cornuta MICHX.
Utricularia gibba L.
Utricularia intermedia HAYNE.
Utricularia minor L.
Utricularia macrorhiza LECONTE. (U. vulgaris L. var. americana GRAY.)

Phrymaceae

Phryma Leptostachya L.

Plantaginaceae

Plantago major L.
Plantago Rugelii DCNE.
Plantago aristata MICHX.

Rubiaceae

Cephalanthus occidentalis L.
Mitchella repens L.
Galium circaezans MICHX. var. *hypomalacum* FERNALD. (Rhodora 39: 450. 1937)

[48] Species of *Gerardia* and *Aureolaria* have not been found north of Galt.

Galium lanceolatum TORR.
Galium boreale L.
Galium Aparine L.
Galium triflorum MICHX.
Galium obtusum BIGEL. (G. tinctorium L.) (Rhodora 37: 443-445. 1935)
Galium latifolium MICHX.
Galium palustre L.
Galium asprellum MICHX.
Galium trifidum L.

Caprifoliaceae

Sambucus canadensis L.
Sambucus pubens MICHX. (S. racemosa L.)
Viburnum trilobum MARSH. (V. Opulus var. americanum (MILL.) AIT.
Viburnum acerifolium L.
Viburnum cassinoides L.
Viburnum Lentago L.
Viburnum affine var. *hypomalaçum* BLAKE. (V. pubescens (AIT.) PURSH, in part) (Rhodora 20: 14. 1918)
Triosteum perfoliatum L.
Symphoricarpos albus BLAKE.
Linnaea borealis L. var. *americana* (FORBES) REHD.
Lonicera canadensis MARSH.
Lonicera oblongifolia (GOLDIE) HOOK.
Lonicera hirsuta EAT.
Lonicera dioica L.
Lonicera dioica var. *glaucescens* (RYDB.) BUTTERS. (L. glaucescens RYD.)
Diervilla Lonicera MILL.

Valerianaceae

Valeriana edulis NUTT.
Valeriana uliginosa (T. & G.) RYD.

Cucurbitaceae

Echinocystis lobata (MICHX.) T. & G.

Campanulaceae

Campanula americana L.
Campanula aparinoides PURSH.
Campanula rotundifolia L. var. *intercedens* (WITASEK.) FARW.

Lobeliaceae

Lobelia cardinalis L.[49]
Lobelia siphilitica L.
Lobelia Kalmii L.
Lobelia inflata L.
Lobelia spicata LAM. var. *originalis* McVAUGH. (Rhodora 38:241-263; 276-298; 305-329; 346-362. 1936)
Lobelia spicata LAM. var. *campanulata* McVAUGH.

Compositae

Eupatorium maculatum (L.) DARL. (Rhodora 22:57-70. 1920 and 39: 297-306. 1937)
Eupatorium perfoliatum L.
Eupatorium rugosum HOUTT. (E. urticaefolium REICHARD.) (Rhodora 40:293. 1938)
Liatris cylindracea MICHX.
Grindelia squarrosa (PURSH.) DUNAL.
Solidago squarrosa MUHL.
Solidago bicolor L.
Solidago hispida MUHL.
Solidago caesia L.
Solidago latifolia L.
Solidago canadensis L.
Solidago juncea AIT.
Solidago neglecta T. & G.
Solidago gigantea var. *leiophylla* FERNALD. (S. serotina AIT.) (Rhodora 41:457. 1939)
Solidago altissima L.
Solidago nemoralis AIT.
Solidago patula MUHL.
Solidago rugosa MILL.
Solidago uniligulata (DC.) PORTER.
Solidago uliginosa NUTT.
Solidago ohioensis RIDDELL.
Solidago graminifolia (L.) SALISB.
Aster divaricatus L.
Aster macrophyllus L.
Aster azureus L.
Aster cordifolius L.
Aster sagittifolius WEDEMEYER. ex. WILLD.

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[49] This beautiful plant has become extremely rare, if not extinct. I have not heard of it being found in recent years.

Aster sagittifolius var. *urophyllus* LINDL.
Aster Lindleyanus T. & G.
Aster novae-angliae L.
Aster laevis L.
Aster longifolius LAM.
Aster junceus AIT.
Aster paniculatus LAM. (Rhodora 35: 28-32. 1933)
Aster Tradescanti L.[60]
Aster puniceus L.
Aster ericoides L. (A. multiflorus AIT.) (Rhodora 32: 138. 1930)
Aster umbellatus MILL.
Aster ptarmicoides T. & G.
Aster lateriflorus (L.) BRITT. (Rhodora 30: 172-173. 1928)
Erigeron canadensis L.
Erigeron pulchellus MICHX.
Erigeron philadelphicus L.
Erigeron ramosus (WALT.) BSP.
Erigeron annuus (L.) PERS.
Antennaria neglecta GREENE.
Antennaria canadensis GREENE.
Antennaria neodioica GREENE.[61]
Antennaria plantaginifolia (L.) RICHARDS.
Antennaria fallax GREENE.
Antennaria petaloidea FERNALD.
Anaphalis margaretacea var. *intercedens* HARA. (Rhodora 41: 391. 1939)
Gnaphalium obtusifolium L. (G. polycephalum MICHX.)
Gnaphalium Macounii GREENE. (G. decurrens IVES.)
Gnaphalium uliginosum L.
Polymnia canadensis L.
Ambrosia trifida L.
Ambrosia elatior L. (A. artemisiifolia L.)
Xanthium canadense Mill.
Xanthium echinatum MURR.
Heliopsis scabra DUNAL.
Rudbeckia hirta L.
Rudbeckia laciniata L.
Helianthus divaricatus L.
Helianthus giganteus L.

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[60] Wiegand and Eames (1925, p. 407), drop the name *A. Tradescantii* and consider it, in part, as *A. paniculatus*. Deam (1940, p. 942) also drops *A. Tradescantii* and describes it under *A. interior*. See Rhodora 35: 35-36. 1933.)

[61] No attempt has been made to segregate the varieties of *A. neodioica*.

Helianthus decapetalus L.
Helianthus tuberosus L.[52]
Helianthus strumosus L.
Bidens cernua L.
Bidens cernua L. forma *minima* (HUDS.) LARS.
Bidens comosa (GRAY) WIEGAND.
Bidens connata MUHL.
Bidens frondosa L.
Bidens vulgata GREENE.
Helenium autumnale L.
Achillea millefolium L.
Artemisia caudata MICHX.
Artemisia gnaphalodes NUTT.
Petasites palmatus (AIT.) GRAY[53]
Erechtites hieracifolia (L.) RAF.
Senecio aureus L.
Cirsium muticum MICHX.
Cirsium discolor (MUHL.) SPRENG.
Lactuca canadensis L.
Lactuca biennis (MOENCH.) FERNALD. (L. spicata (LAM.) HITCHC.) (Rhodora 42: 300. 1940)
Lactuca hirsuta MUHL.
Prenanthes altissima L.
Prenanthes alba L.
Hieracium scabrum MICHX.
Hieracium Gronovii L.
Hieracium canadense MICHX.

SUMMARY

It is evident that the flora of Waterloo county is composed of plants of three overlapping floral zones. First, the Transcontinental Zone (Adams, 1938), descends southward, and members of this zone are to be found throughout the county. Second, the Alleghenian Zone (Merriam, 1898), or Eastern Zone (Adams, 1938), is the main floral zone and extends throughout the whole county. The third is the Carolinian Zone (Merriam, 1898), or Interlacustrine (Adams, 1938), which forms a small but significant portion of the flora of the southern part of the county. From the data presented on the distribution of the Carolinian flora it would seem that the northern limit should be extended into this county to include that area south of Galt, and thus correspond to the limit as set by Adams, 1938. It is also seen that species of the Carolinian flora extend well northward along the shore of Lake Huron to the vicinity of Wingham, and that a few even reach the Bruce Peninsula.

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[52] This may have been introduced by the Indians. At least two places where it has been found in the county are known to have been Indian encampments.

[53] This more northern species is very rare in this area.

In this thesis 1,191 species, varieties and forms are reported as occurring in Waterloo county, and 102 indigenous species, varieties and forms are listed that have not been previously recorded.

SUMMARY OF FAMILIES, GENERA, SPECIES, VARIETIES, AND FORMS

Plants that are represented only by a variety, are listed as a species.

Families	Genera		Species		Varieties		Forms	
	Native	Introduced	Native	Introduced	Native	Introduced	Native	Introduced
Pteridophyta								
Ophioglossaceae	2		4				1	
Polypodiaceae.	13		22		3			
Osmundaceae.	1		2					
Equisetaceae.	1		6					
Lycopodiaceae. .	1		4					
Selaginellaceae	1		1					
Spermatophyta								
GYMNOSPERMAE								
Taxaceae. .	1		1					
Pinaceae. . .	7		8					
Angiospermae								
MONOCOTYLEDONEAE								
Typhaceae.	1		2					
Sparganiaceae. .	1		4					
Potomogetonaceae	1		14					
Najadaceae. . .	1		1					
Scheuchzeriaceae.	2		3					
Alismaceae. . .	2		4					
Hydrocharitaceae.	2		2					
Gramineae.	32	11	78	34	5			
Cyperaceae. . .	10		119		5			
Araceae.	4		5				1	
Lemnaceae. . . .	2		3					
Pontederiaceae. .	1		1					
Juncaceae. .	2		12		2		1	
Liliaceae . . .	14	2	23	3				
Dioscoreaceae. . .	1		1					
Iridaceae.	2		5					
Orchidaceae. . . .	12		25		1			

Families	Genera		Species		Varieties		Forms	
	Native	Introduced	Native	Introduced	Native	Introduced	Native	Introduced
Dicotyledoneae								
Saururaceae.....	1		1					
Salicaceae.......	2		17	4	1			
Myricaceae......	1		1					
Juglandaceae....	2		5					
Betulaceae......	5		11		1			
Fagaceae........	3		9					
Ulmaceae.......	2		4					
Moraceae.......	1			1				
Urticaceae......	5	1	6	2				
Santalaceae......	1		1					
Aristolochiaceae..	1		1					
Polygonaceae....	2	1	16	5	1		1	
Chenopodiaceae..	2	1	3	6				
Amaranthaceae ..	1		1	4				
Portulacaceae ...	2	1	2	1				
Caryophyllaceae..	4	5	6	12				
Nymphaeaceae...	3		3					
Ceratophyllaceae.	1		1					
Ranunculaceae ..	11		30		1			
Berberidaceae....	3	1	3	1				
Menispermaceae..	1		1					
Lauraceae.......	2		2					
Papaveraceae....	1	1	1					
Fumariaceae.....	3	1	3	1				
Cruciferae.......	6	14	15	21		1		
Sarraceniaceae...	1		1					
Droseraceae.....	1		2					
Crassulaceae.....	1	1	1	1				
Saxifragaceae....	6		10		1			
Hamamelidaceae.	1		1					
Platanaceae......	1		1					
Rosaceae........	15	1	45	8	2			
Leguminosae.....	8	8	20	20		1		
Oxalidaceae......	1		2					
Geraniaceae.....	1		3	1				
Linaceae........	1		1	1				
Rutaceae........	1	1	1	1				
Polygalaceae.....	1		4					
Euphorbiaceae...	2		6	4				
Callitrichaceae...	1		1					
Limnanthaceae...	1		1					
Anacardiaceae ...	1		4					
Aquifoliaceae....	2		2					
Celastraceae.....	2		3					

Families	Genera		Species		Varieties		Forms	
	Native	Introduced	Native	Introduced	Native	Introduced	Native	Introduced
Staphyleaceae....	1		1					
Aceraceae.......	1		6					
Balsaminaceae...	1		2					
Rhamnaceae.....	2		2	2				
Vitaceae........	2		4					
Tiliaceae........	1		1					
Malvaceae......		2		3				
Guttiferae.......	1		7					
Cistaceae........	2		2					
Violaceae.......	1		14	1	2			
Thymelacaceae...	1		1					
Elaeagnaceae....	1		1					
Lythraceae......		1		1				
Oenotheraceae...	4		12					
Haloragidaceae...	2		4					
Araliaceae.......	2		4					
Umbelliferae.....	12	4	12	4				
Cornaceae.......	1		6					
Ericaceae.......	14		23		2			
Primulaceae.....	4		9					
Oleaceae.......	1		3					
Gentianaceae....	3		5					
Apocynaceae....	1	1	2	1	2			
Asclepiadaceae...	1		4					
Convolvulaceae..	2		3	1				
Polemoniaceae...	1		2					
Hydrophyllaceae.	1		2					
Boraginaceae....	6	2	7	8				
Verbenaceae....	1		4					
Labiatae...... .	11	8	18	12	1			
Solanaceae......	2	1	5	1				
Scrophulariaceae .	12	3	19	9				
Orobanchaceae ..	3		3					
Lentibulariaceae..	1		5					
Phrymaceae.....	1		1					
Plantaginaceae .	1		3	1				
Rubiaceae.......	3		12	2				
Caprifoliaceae....	7		16	1	1			
Valerianaceae...	1		2	1				
Dipsacaceae.....		1		1				
Cucurbitaceae.. .	1		1					
Campanulaceae..	1		3	2				
Lobeliaceae......	1		5		1			
Compositae......	25	18	89	41	2	1		
Totals.... ..	371	91	926	224	34	3	4	

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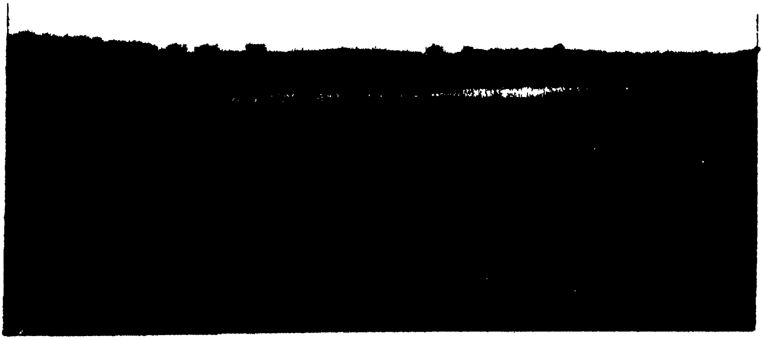
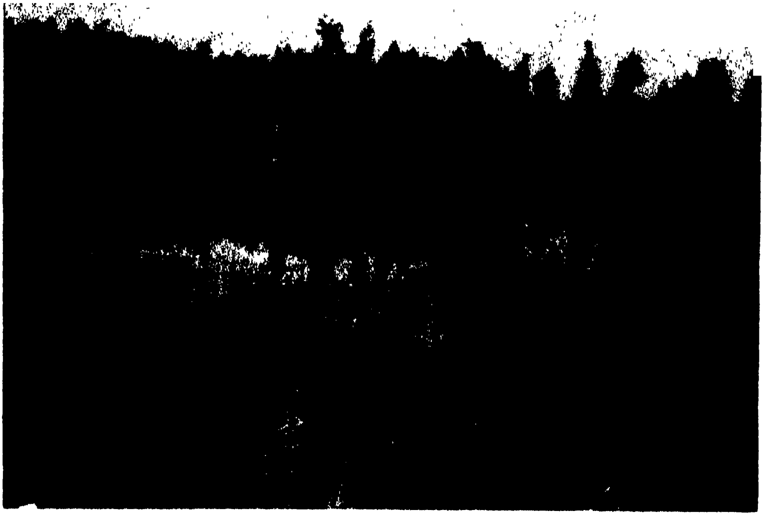
Saururus cernuus L. (Lizard's Tail)

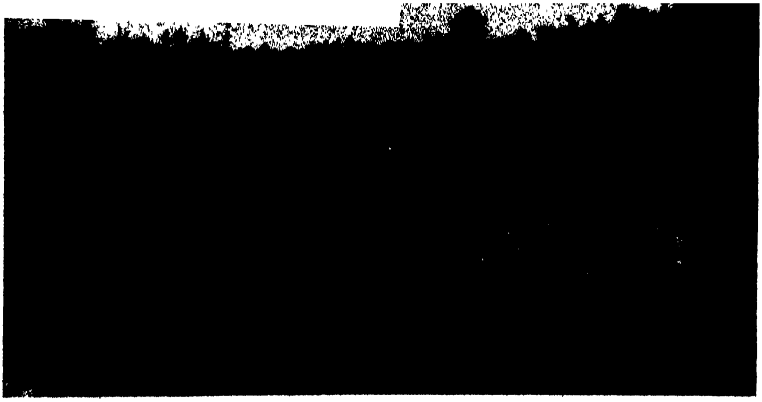
View across one lake at Wrigley's Corners



Another lake at Wrigley's Corners in July



View of edge of Altrieve Lake, Galt

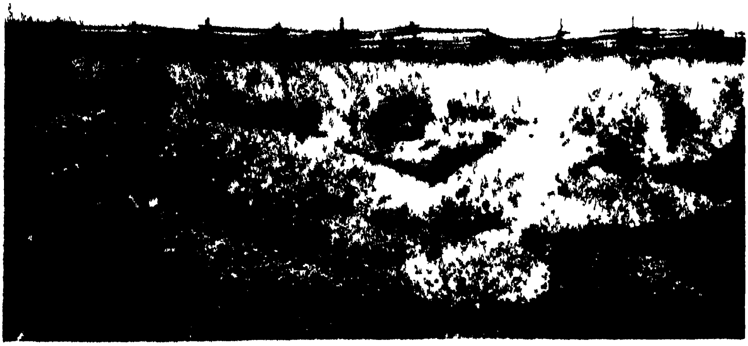


View along centre of Altrieve Lake, Galt

View of eastern end of Paradise [illegible] St. Clements

View of edge of Paradise Lake, St. Clements

A sand pit at Kitchener



A gravel pit near Elmira

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